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DEVELOPMENT PROGRAM OF DUAL MODE IMPACT DELAY MODULE FOR ARTILL--ETC(U)
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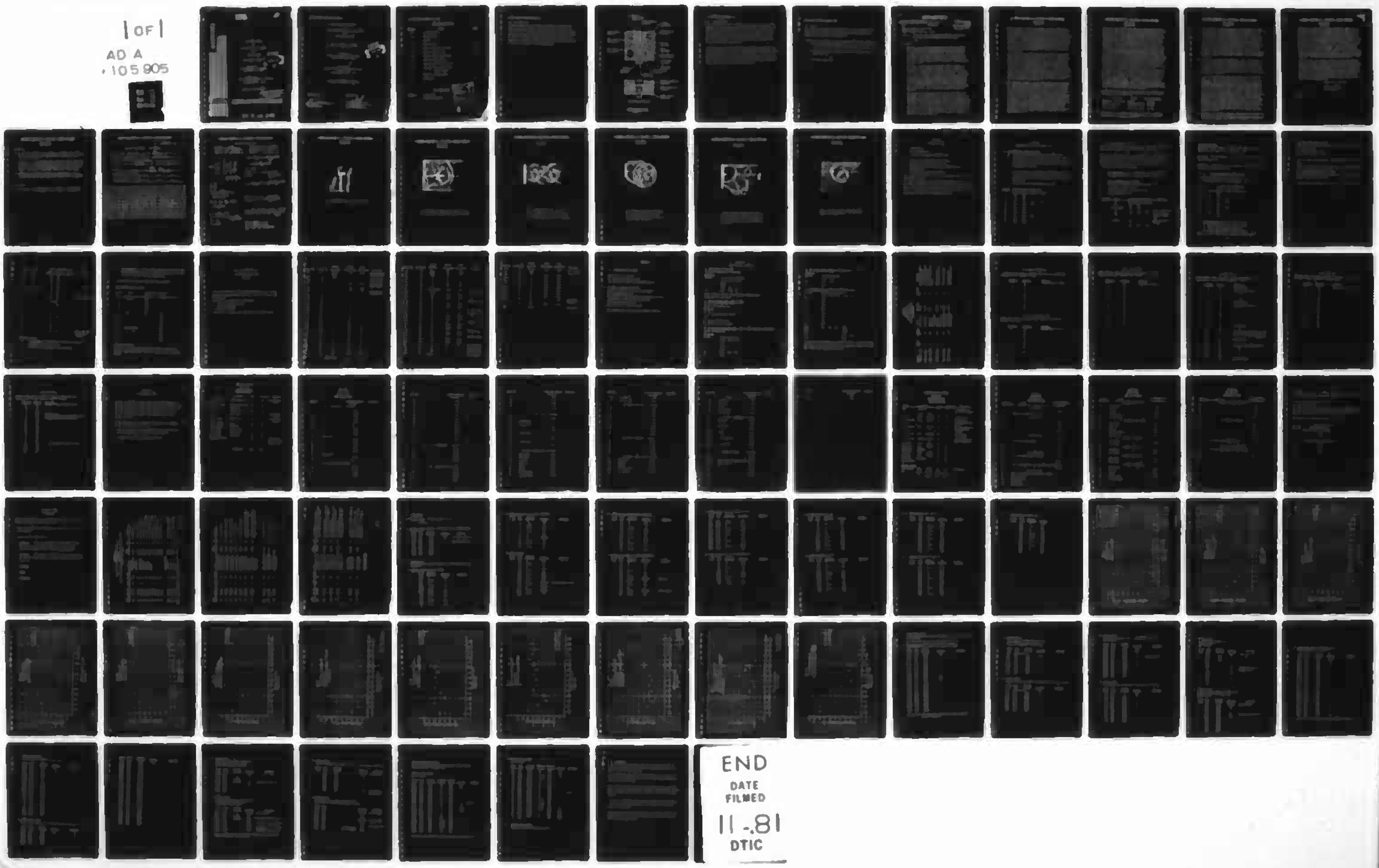

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DEVELOPMENT PROGRAM

OF

DUAL MODE IMPACT DELAY MODULE

FOR

ARTILLERY FUZES

FINAL TECHNICAL REPORT

Prepared for:
US Army Armament R & D Command
Dover, New Jersey 07801

Prepared by:
Bulova Systems & Instruments Corporation
P.O. Box 189
Valley Stream, N.Y. 11582

Contract No. DAAK10-78-C-0269

BULOVA SYSTEMS & INSTRUMENTS CORPORATION

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6

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9

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Submitted by:

10

G. Thomas
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TABLE OF CONTENTS

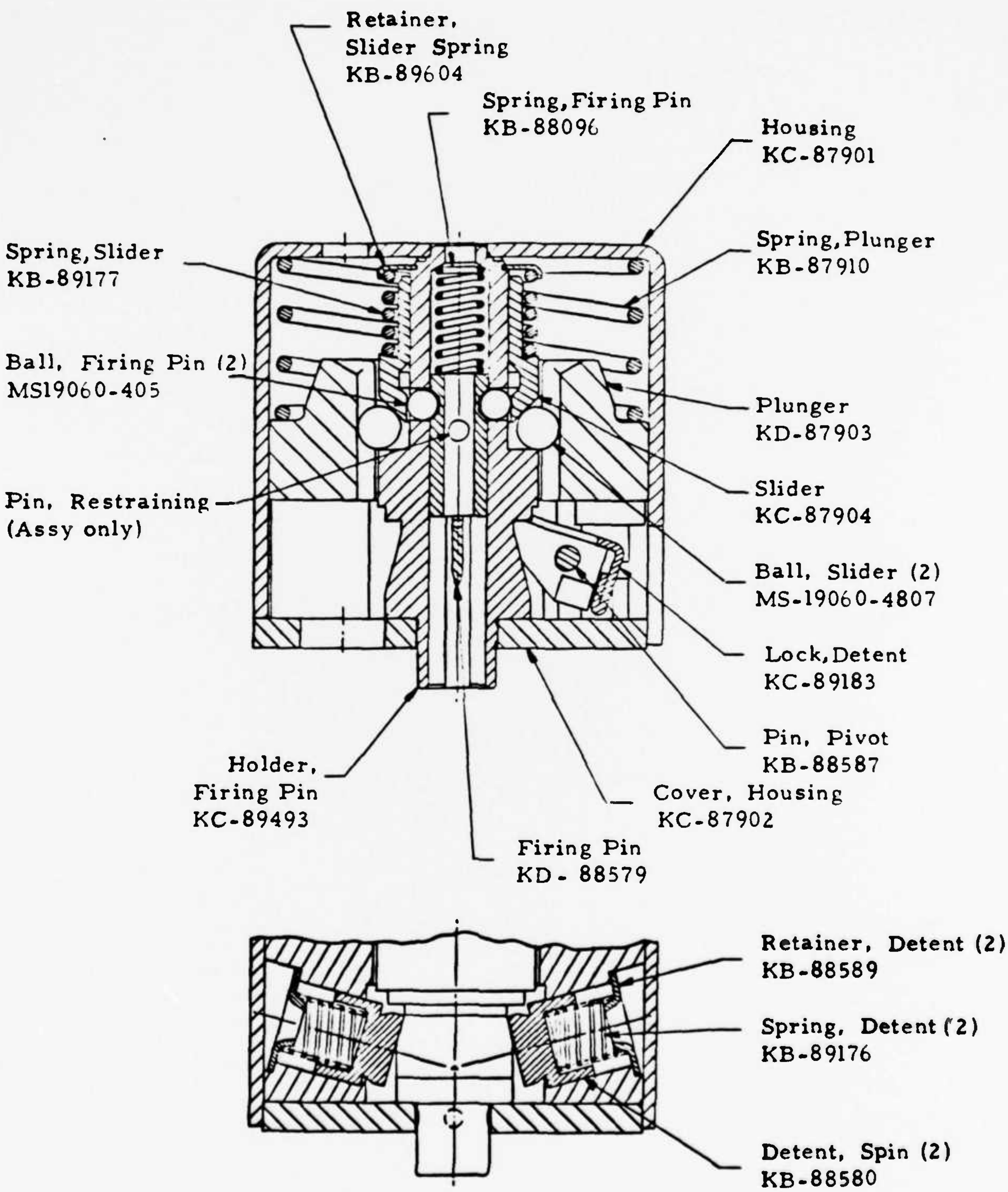
Section	Title	Page
1.0	INTRODUCTION	1
2.0	BACKGROUND	3
3.0	SCOPE	4
3.1	Stresau Report	5
3.2	Phase I - Environmental Tests	19
3.3	Phase I - Ballistic Tests	26
3.4	Phase II - Environmental Tests	30
3.5	Phase II - Ballistic Tests	33
3.6	Phase III - Environmental Tests	39
3.6.1	Phase III - Environmental Tests Updated Design	47
3.7	Phase III - Ballistic Tests	52
3.8	Conclusion	86

ILLUSTRATIONS

Figure 1	Section View Dual Mode Assembly	2

1.0 INTRODUCTION

This Final Technical Report is prepared to summarize the progress on Contract DAAK10-78-C-0269 covering the period from 27 July 1978 thru 31 December 1979. The objective of this effort was to improve the development of a Dual Mode Impact Delay Device (previously developed on Contract DAAA21-77-C-0080) thru a hardware analysis phase to demonstrate design confidence and reliability of performance in the artillery firing environment. See Figure I for drawing of the latest configuration.



SECTION ROTATED 90°

DMID CUTAWAY VIEW

Figure I

2.0 BACKGROUND

The M1 Plunger Delay Element currently in use on artillery fuzes is limited in usefulness due to the fixed pyrotechnic delay time employed. The effect against thin targets is that the round can pass thru the wall of a typical thin target, go thru an empty space and enter the opposite wall before detonation. The effect against thick targets is that the round will detonate prior to penetration of the wall into the occupied space. Both cases illustrate less than optimum effectiveness against all possible target thickness.

The Dual Mode Impact Delay provides a delay proportional to target thickness so that detonation occurs as a function of target penetration regardless of thickness. This is accomplished by sensing the deceleration on impact. Upon reduction of deceleration force to a level corresponding to target penetration, the unit senses this and detonation occurs. This mode of operation therefore provides optimum projectile effectiveness regardless of target thickness.

3.0 SCOPE

The Scope of Work for this contract was divided into 3 phases with each phase having specific improvements incorporated and tested for sensitivity, environment and ballistics. Each are discussed below.

In addition, as part of Phase I, a study was conducted by R. Stresau Laboratory to:

A- Evaluate sensitivy of the M55 Detonator by means of a flying plate test and compare with the sensitivity of a less sensitive material (lead oxide).

B- Evaluate the ability of a reduced output M99 to initiate the acceptor M55 Detonator

Results of the above study follow.

R. STRESAU LABORATORY, Inc.
RESEARCH — DEVELOPMENT — EVALUATIONS

EXPLOSIVE DEVICES, SYSTEMS AND INSTRUMENTATION

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Spooner, Wisconsin 54801

RSLR 78-44
(E-0548-8)

3.1

7 December 1978

Bulova Systems & Instruments
Post Office Box 189
Valley Streams, New York 11582

Subject: M739 Fuze, Dual Mode Initiation Device P/N KF88590
Initiation of M55 Detonator by M99 Detonator

Re: P. O. 5822

Gentlemen:

1. Reported herein are efforts to analyze factors involved in the initiation of the M55 Detonator by the M99 Detonator of the M739 Fuze as affected by the Dual Mode Initiation Device P/N KF88590 as proposed by us. This analysis will be based on results of penalty tests in which the test variables will include loading and other design variables of both detonators and dimensions of inert components of the system, especially the paths through the DMID with the M739 set for point detonation, as directed in the referenced purchase order.

2. Although, on the basis of qualitative considerations, it seems quite obvious that the subject transfer should be highly reliable, quantative assessment of the reliability is difficult because of the inherent randomness of some of the controlling factors in the transfer process. An examination of the design, in the light of experience with explosive initiation systems, leads to the conclusion that the agency of this transfer is rapidly moving fragments either of the "retainer" of the M99 detonator or of the point of the firing pin which might be torn loose. When fuze hardware, including detonators, became available for testing, it was found that the point of the firing pin was torn loose (see Photo 548-1). It is reasonable to assume that the tip of the firing pin is the principal agency of detonation transfer.

3. The angular attitude of the tip of the pin at impact can be expected to greatly affect its effectiveness in this function. The point of the firing pin is, of course, of the standard design and dimensions prescribed for firing pins for M55 detonators, which, when initiated as prescribed must fire reliably on a one inch-ounce impact. It can be expected that those firing pin tips which strike point end first will result in highly reliable initiation. The two back corners may be nearly as effective, edge on impact less so, and flat normal impact may require many times the energy required for initiation by a top hitting point first. As a result, a very large random variation in the tip velocity required for initiation is to be expected.

4. Similar consideration of the complexity of the interaction of factors which must affect energy and momentum transfer from the M99 detonator to the firing pin tip leaves no room for doubt that the realized velocity of impact of the tip on the M55 detonator also varies over a wide range. The distributions of kinetic energy among the fragments as well as their trajectories are necessarily largely random, particularly as they affect the kinetic energy and momentum of the fragments which penetrate the central hole of the firing pin to a point where they can contribute to the breaking and acceleration of the firing pin tip. The momentum and kinetic energy of the tip are those remaining after deducting the losses of inelastic impact and the energy required for fracture of the tip from the firing pin.

5. The reliability with which the M55 detonator will be fired by the M99 Detonator in the subject fuze is the probability that the velocity with which the tip of the firing pin will exceed that necessary for initiation. It, thus depends upon the comparison of two quantities each of which, as has been shown in foregoing paragraphs, is subject to large random variation. The extreme sensitivity of the M55 Detonator in combination with observation of substantial damage to inert or insenstive components wrought by the firing pin tip (Photo 548-2) lead to intuitive confidence that the lowest realizable tip velocity exceeds the highest velocity required to initiate an M55 detonator. Experimental data in support of this confidence seemed elusive from the start and was, indeed, rather difficult to attain. A variant of the "Varicomp" approach was used to obtain data which was extrapolated statistically to obtain estimates of reliability.

6. The "Varicomp" method in its broadest definition is a method of detonation transfer probability assessment which involves the substitution, for an explosive specified in the design, of another material of differing sensitivity. If both materials have been calibrated, using the same test, in terms of the relationship between initiation probability and the magnitude of the initiating stimulus, and if the surrogate has been judiciously chosen, it is possible to predict the probability of initiation of the design explosive from results obtained with the surrogate. The approach is discussed in more detail in Enclosure A. As is pointed out in References 1 and 2, it is essential to the validity of reliability estimates made by the Varicomp method that the calibration test simulate as closely as practical (in particular with respect to the detonation transfer mechanism) that which applies to the system being considered, or alternately that data be obtained by methods which, in effect, "bracket" conditions in the system as designed.

7. The choice of a suitable Varicomp surrogate for the M55 was based on a combination of consideration including availability, sensitivity relative to that of the NOL 130 priming mix used as the priming charge of the M55, and unambiguous response characteristics. Of course, any surrogate should be sensitive enough to be at least reasonably consistently initiated when substituted in the system to be evaluated. However, since efforts to select and calibrate the surrogate (and calibrate the M55 Detonators) were started before receipt of the M99 detonators, some of the other factors were the subject of experimental effort before experimental determination of performance of surrogates in the system as designs could be made. The M55 Detonator must (per specification) be initiated by a one inch-ounce impact using its standard firing pin. None of the surrogates which were considered can be initiated by any impact which can be administered by a dropped weight on the standard firing pin[3]. Assuming such data to be applicable, almost any currently used pure explosive (including lead azide and lead styphnate) would be quite appropriate as a surrogate. However, the combination of low velocity and relatively large mass with the nearly pointed firing pin (it has a 0.007 flat) removes this test so far from simulation[1,2] of the subject interface as to destroy the credibility of any prediction made on this basis. A Proportional Gap Test, with 50 mil diameter donors and M55 detonators as acceptors was performed with the expectation that it, with existing stab sensitivity data might be shown to "straddle" conditions at the subject interface. The results of this test, which when compared with existing data[4], indicates that even PETN is too senstive for use as a surrogate for the M55, made any effort to realize this expectation academic. It was decided, at this point, to try to simulate the conditions of the system as closely as possible in the calibration tests. All subsequent calibration tests were determinations of the velocity of an aluminum disc 0.018 thin by 0.075 diameter necessary for threshold initiation of the M55 detonator or a Varicomp surrogate.

8. In the calibration tests, the acceptors were M55 detonators or M55 detonator cups loaded with candidate Varicomp surrogates. The candidates surrogates were:

Explosive	Source	Loading Pressure
Dextrinated Lead Azide	DuPont	30 Kpsi
PETN	Trojan Powder Co.	30 Kpsi
Barium Styphnate	R. Stresau Lab., Inc.	10 Kpsi
Lead Styphnate	Olim Industrial	10 Kpsi

9. Preliminary to the calibration tests, each of the candidates was tried as a surrogate in the subject fuze, with the DM1D in place and set for point detonator.

PETN and barium styphnate were eliminated because they were not initiated by the M99 Detonator in the interface as described in paragraph 1. Lead styphnate was eliminated because its reaction, in the subject interface, was relatively mild, with manifestations (see Photo 548-3) usually refered to as those of "low order detonation" requiring subjective judgment for characterization as "fire" or "failure". Dextrinated lead azide, loaded in M55 cups and substituted for M55 detonators in the system was consistently and unmistakably detonated (Photo 548-4). Dextrinated lead azide was, tentatively, chosen as a Varicomp surrogate. On the basis of stab sensitivity data[3], it would be predicted that any system which would initiate dextrinated lead azide would be a highly reliable initiator of the NOL 130 priming charge. However, as has been pointed out, such predictions are probably misleading because of the difference in mechanisms involved in stab and fragment initiation.

10. In a thirty-trial Bruceton calibration test (as described at the end of paragraph 7, Bruceton 548-4) of M55 detonators the mean velocity threshold velocity (50% point) for initiation was found to be 155 meters per second with a standard deviation of 0.0605 log units. By statistical extrapolation as illustrated in SK 78-4-1 (Enclosure A) the velocity required for 99.975 (minimum at 95% confidence) reliable initiation would be 430 meters per second (see enclosed calculation sheet for Bruceton Test 548-1).

11. It was found that lead azide was initiated, in the calibration test, by a flyer plate impacting at 214 meters per second. Thus, a less sensitive acceptor was necessary as a Varicomp surrogate. However, as mentioned above, all other available candidates had been eliminated. A few efforts were made to desensitize lead azide with additives but it became apparent that the development of a desensitized lead azide of satisfactory characteristics would be a separate project of a magnitude beyond the scope of the referenced purchase order. The interposition of an aluminum barrier in contact with the input surface of the acceptor was used as an additional penalty. A series of experiments were performed to choose an appropriate thickness of this barrier. In the calibration test, 430 meters per second served as the criterion. It was found that the "cut-off" barrier thickness is between six and seven mils and, in five trials with 8.8 mil barriers none of the acceptors were initiated. On the basis of this last finding, it has been shown that, at 95% confidence, that the mean velocity (that for 50% initiation), for initiation of the dextrinated lead azide with a 8.8 mil cover is at least 430 meters per second.

12. In tests of the subject interface using dextrinated lead azide acceptors with 10.6 mil barriers, the acceptors detonated in four of five trials. In a repeat test, using 8.8 mil barriers, the score was, again, four in five. Combining these data, in

eight of ten trials with aluminum barriers at least 8.8 mils thick, dextrinated lead azide detonators were initiated by the M99 detonator at the subject interface defined in paragraph 1, above. By binomial statistics, eight successes in ten trials indicate a minimum reliability (at 95% confidence) of 49.3%, which, for purposes of the analysis such as this, is not significantly different from 50%. Taken with the results cited in paragraph 11, the foregoing demonstrates that the stimulus transferred from the M99 detonator to the M55 detonator at the subject interface is equivalent to that delivered by the calibration test at 430 meters per second as the results, given in paragraph 10, of the calibration test of the M55 detonator indicate, the minimum reliability, predicted at 95% confidence when initiated in the calibration test at 430 meters per second is 99.975%. It can be predicted, from the foregoing, that the reliability of detonation transfer between the M99 detonator and the M55 detonator at the subject interface should be at least 99.975% at 95% confidence.

This prediction, of course, is subject to the usual reservations, pointed out in Enclosure A, which apply to the prediction of high degrees of safety or reliability by extrapolation from penalty tests performed with small samples. These reservations are particularly applicable to the present case in view of the probable variability of the stimulus transmitted to the M55 detonator, pointed out in Paragraph 3, hereof. In support of the rationale of paragraph 3, note in Photos 548-5 and 548-6, which are of the acceptors which failed in the Varicomp tests of the actual interface, that both acceptors bear imprints which could have resulted only from flat side-on impact of the firing pin tips.

Respectfully submitted,

R. H. Stresau

R. H. Stresau

RHS/mrb

Enclosure A

RSLR 78-44
(E-0548-8)

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1. Ayres, J. N., Hampton, L. D., Kabik, I., Solem, A. D., "Varicomp, A Method for Determining Detonation Transfer Probabilities". NavWeps Report 7411, U. S. Naval Ordnance Laboratory, White Oak, MD, January 1961.

2. Stresau, R. H., "Development of the Varicomp Method, Expansion of Applicability (To Determine Detonation Transfer Probabilities With Reduced Dependence Upon System Variables) Part 6 Analysis of Data and Presentation in Forms Adapted to Safety and Reliability Estimation for Explosive Trains", RSLR 74-4 for the U.S. Naval Weapons Center, China Lake, California, 5 April 1974.

3. Hampton, L. D. Savitt, J. Starr, L. E. and Stresau, R. H., "Priming Explosive Evaluation Tests", NavOrd 2824 U. S. Navord Ordnance Laboratory, White Oak, Silver Spring, MD, 19 March 19[illegible].

ENCLOSURE A

Stresau, R. H., D. H. Chamberlain, M. J. Pesko, "Safety and Reliability Testing of Fuze Explosive Trains", RSLR 78-4, 10 March 1978.

R. STRESAU LABORATORY, Inc. — STAR ROUTE — SPOONER, WISCONSIN

Date 11/27/78

BRUCETON DATA SHEET No. 548-4

Type of Test Flying Disc Item M55 Detonator Dwg No. ______

Variable Velocity Step Size .025 Log Units

Criterion of Fire Shattered Rotor ______

Disc Material Aluminum Dia. .075 Thickness .018

Explosives
Flash Charge NOL 130 Int.Charge Lead Azide (PVA) Base Charge RDX Acc. ______

Charge Dia or Other Size
Flash Charge ______ Base Charge ______ Donor ______ Acc. ______

Loading Pressure or Density
Flash Charge ______ Base Charge ______ Donor ______ Acc. ______

m s

[illegible]25																									X							
[illegible]70.4	X											X				X				X				O		X						
[illegible].8											O		X		O		X		O		X		O				X		X			
5[illegible]7		X		X						O				O				O				O						O		X		O
430	O		O		X				O																						O	
[illegible]3[illegible]						X		O																								
[illegible]277							O																									

BRUCETON CALCULATIONS

PROJECT 548
BRUCETON NUMBER 548-4
BRUCETON DATE 11/27/78

CALCULATION DATE 12/4/78
CALCULATIONS BY [illegible]
CHECKED (?) [illegible]

	X	O	i	n	ni	ni^2
			+4			
			+3			
	1	0	+2	1	2	4
	4	1	+1	4	4	4
160.8	5	4	0	5	0	0
	3	6	-1	3	-3	3
	1	4	-2	1	-2	4
	1	1	-3	1	-3	9
	0	1	-4			
				15	-2	24
				N	A	B

N 15
A -2
B 24

$\bar{X} = X_o + d\left(\frac{A}{N} \pm .5\right)$
$= 160.8 + 9.1\left(\frac{-2}{15} - .5\right)$
$= 155.046$ m/s

$\bar{M} = \frac{B}{N} - \left(\frac{A}{N}\right)^2 = \frac{24}{15} - .133$
$= 1.5822$

S = 2.6 STEP
σ = (S) (step size) = .065 log units
G = 1.3
H = 1.95

$\sigma\bar{X} = \frac{(\sigma)\,(G)}{\sqrt{N}} = \frac{.065 \times 093}{\sqrt{15}}$
$= .0156$ log units

T = 1.76

$\sigma\bar{X} <= (T)\ (\sigma\bar{X}) = .0275$ log units
at 95%

$\sigma_{\sigma} = \frac{(\sigma)\ (H)}{\sqrt{N}} = .0327$ log units

$\sigma_{\sigma} <= (T)\ (\sigma_{\sigma}) = 0.0576$ log units
at 95%

$D_s <= \frac{X_s - \bar{X} - \sigma_{\bar{X}}\ (< \text{at } 95\%)}{\sigma + \sigma_{\sigma}\ (< \text{at } 95\%)} = 3.487$ (for 430 m/s)
at 95%

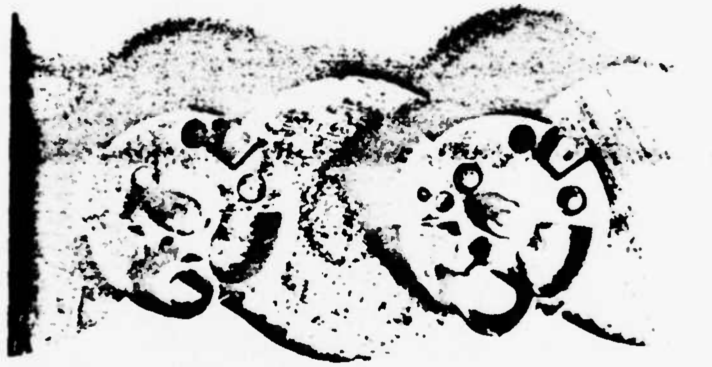
Maximum [redacted] Failure
Rate at 95% Confidence
for 430 m/s = 0.00025

Firing Pin (KB88579) of DMID KF88590 with tip blown off by M99 Detonator in M739 Fuze

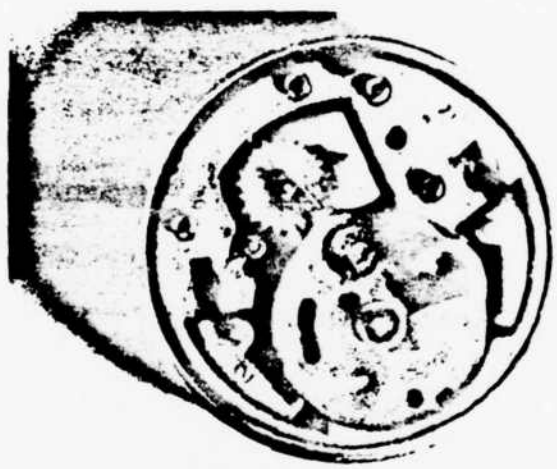
RSLR 78-44
(E-0548-8)

M739 Fuze Rotor, showing damage to detonator cup (which had been loaded with PETN) by output of M55 Detonator filtered through DMID (RF88590)

RSLR 78-44
(P-0548-8)



Rotors from M739 Fuzes in which E99 Detonators had been fired with DM1b set for, point detonation. Rotor at left (obverse side of that shown in Photo 548-2) had contained an [illegible] cup loaded with PETN. Rotor at left had contained an M55 cup loaded with Lead Styphnate



S&A Module of M749 Fuze in which the M55 Detonator had been replaced with an M55 Detonator Cup loaded with dextrinated lead azide. The M99 Detonator had been fired with the DMID Set for point detonation.

RSLR 78-44
(K-0548-8)

Segment of Rotor of M739 Fuze with M55 Cup loaded with dextrinated lead (acceptor) azide and covered with aluminum barrier. Acceptor had failed when M99 detonator was fired with DHLD set for point detonation. Note imprint of firing pin point striking flat side on.

Barrier disc from trial similar (in both arrangement and result) to that described in caption of Photo 548-5

PHASE I

3.2 BULOVA TESTS

300 Units Made

100 For Ballistic Tests

100 For Environmental and Sensitivity Tests

All Above Assemblies contained the following:

1. Brass Plungers slotted for ball clearance.
2. Housings and covers modified using government furnished Mi Delay assembly parts.
3. Aluminum (machined) firing Pin Holders.
4. Other parts used were the same as previous contract (dwg. no. KF-88590).

METHOD OF TESTING:

All Plunger sub-assemblies were tested for non-arming (1100 RPM) and arming (2000 RPM) before final assembly and then repeated after final assembly. After environmental tests each unit was checked for non-arm position and then armed. The units were then dropped on a steel plate at a specified height to simulate ground impact and then examined for function.

PHASE I

ENVIRONMENTAL & SENSITIVITY TESTS

A. Sensitivity Tests - Quantity 20 Units

1. All units passed Arming (2000 RPM & Non-Arming (1100) Tests.

2. After Arming Test, all units were checked for Plunger Freedom. It was found that 10 of 20 units witnessed an interference between the spin detents (2) and the shoulder of the Firing Pin Holder when the Plunger was depressed.

   This interference was caused by the accumulation of tolerances on affected parts plus the inconsistant shape (although within draining tolerance) of the detent lock (soft tooling and 2 piece spot-welded construction).
   10 of 20 Units were not tested due to above defect.

Unit No.	FUNCTION DROP HEIGHT (IN.)			
	2 3/4	3 3/4	4 3/4	5 3/4
2	No	Yes		
4	No	Yes		
7	No	No	No	No *
8	No	No	Yes	
10	No	Yes		
12	No	Yes		
14	No	Yes		
15	No	Yes	Yes	
17	No	Yes		
20	No	Yes		

* FAILURE ANALYSIS ON UNIT NO. 7

Failure was due to plunger spring interference (solid height) with plunger which did not allow sufficient travel to release the firing pin balls. (2)

To prove this failure mode, the plunger and spring was reassembled into the housing and the depth of plunger travel was gaged to check functioning distance. Gage measured .198 travel. A min. of .215 travel is needed for function. To correct this condition, the spring lead in diameter on the plunger was chamfered to allow spring to seat properly.

B. Unit configuration: Brass plunger had taper cut on spring guide end for proper spring seating. All other parts same as previous test.

B1. JOLT & JUMBLE TEST 6 UNITS

1. After test all units examined to verify safe position - All OK
2. Verify plunger freedom - All OK
3. Performed Arm/Non-Arm Spin Test - All OK
4. Perform Sensitivity Tests

Unit. No.	Test	Function Drop Height (IN.)			Remarks
		2 3/4	3 3/4	4 3/4	
1	↑	No	Yes		
2	Jolt & Jumble	No	Yes		
3	↓	No	No	No	1 Slider Ball Released
5	↓	No	No	No	Plunger jammed in down pos. approx. .125
4	Jolt Only	No			Broken Detent Lock - No Test
6		No	No	Yes	

FAILURE ANALYSIS

Unit No. 3 Detent protrusion caused interference with outside diameter on Firing Pin Holder. Holder O.D. to be reduced .020 dia.

Unit. No. 5 Plunger jamming due to burr on edge of Plunger. Edges to be radiused on future lots.

Unit No. 4 Broken detent lock was caused by poor spot welding. Parts are to be 1 pc. construction on future lots.

B2. AMBIENT SENSITIVITY TEST 9 UNITS

ALL UNITS SPIN TESTED FOR ARM/NON-ARM - ALL OK

ALL UNITS CHECKED FOR PLUNGER FREEDOM - ALL OK

UNIT NO.		FUNCTION DROP HEIGHT (IN.)		
		2 3/4	3 3/4	4 3/4
7	No	Yes		
8	No	Yes		
9	No	No	Yes	
10	No	No	Yes	
11	No	Yes		
12	No	No	Yes	
13	No	Yes		
14	No	Yes		
15	No	Yes		

C. Unit configuration: DMID Units A thru L (11 Units)

1 Firing Pin holder O.D. was reduced .020 Dia.

2. Plunger Chamfered for Spring Clearance.

3. Plunger Spring modified (ends turned outward)

Dmid units 1 thru 7 - Same as above except item 1 was not modified.

C1. Jolt & Jumble Tests - 11 Units

Units A thru L were subjected to Jolt Test. After test all were checked for safe position - All OK.

Verify plunger freedom - All OK

Arm/Non-Arm Spin Test - All OK

Units E, F, G, H & J were reassembled to M739 fuzes and subjected to Jumble Tests.

After Test, All checks were performed (same as above) All OK except Unit No. J which became loose during test was considered an overtest.

C2. Transportation Vibration Test - 7 Units

Units 1 thru 7 were subjected to transportation vibration test (Ambient) All above checks after test were OK.

All dmid units were then armed and tested for Sensitivity as follows:

	Unit No.	Test	Function Drop Height (In.) 4 3/4	5 3/4	6 3/4	Remarks
C1	A	Jolt	No	Yes		
	B	"	No	Yes		
	C	"	No	Yes		
	D	"	No	Yes		
	E	Jolt & Jumble	No	Yes		
	F	" "	No	Yes		
	G	" "	No	Yes		
	H	" "	No	No		One ball released
	J	" "	No	No	No	Overtest
	K	Jolt	NO TEST			
	L	"	No	Yes		
C2	1	TV	Yes			
	2	"	No	Yes		
	3	"	Yes			
	4	"	No	Yes		
	5	"	Yes			
	6	"	Yes			
	7	"	No *	Yes		*Plunger jammed Down-No ball Release

FAILURE ANALYSIS:

H - One ball released during drop test. Firing pin did not release - no cause found.
J - Locking screw loosened during test.
K - Unit could not be disassembled - (thread stripped)

D. Unit Configuration: 15 Dmid units with stainless steel firing pin holders. Chamfered and radiused brass plungers modified plunger springs (ends turned out) New detent locks (1 pc. construction)

All Arm/Non-Arm and plunger freedom tests were acceptable.

SENSITIVITY TESTS - 15 Units

Unit No.	Test	Function Drop Height (In.) 4 3/4	5 3/4
1	Ambient	Yes	
2	"	Yes	
3	"	Yes	
4	"	Yes	
5	"	Yes	
6	Jolt	No	Yes
7	"	"	Yes
8	"	"	Yes
9	"	"	Yes
10	"	"	Yes
11	Jolt & Jumble	"	No
12	" "	"	Yes
13	" "	"	Yes
14	" "	"	Yes
15	" "	"	Yes

FAILURE ANALYSIS:

Unit No. 11 - Slider Ball came out but did not function. Firing Pin was depressed slightly and released. Small burr was found on I. D. of firing pin holder.

3.3 BALLISTIC TEST RESULTS

YUMA PROVING GROUND

PHASE I

70 Dmid Units with Brass Plungers (Modified with Exit Channels for Ball Relief) were assembled to Inert M739 Fuzes and fired for recovery using the following:

Units 1 thru 35 - 155mm, Zone 2, HQE Set SQ

1 thru 7, 1100 Mils elevation,

8 thru 22 1050 Mils

23 thru 35 1075 Mils

Units 36 thru 70 - 155mm, Zone 7 LQE, Set Delay 315 Mils Elevation.

ROUND NO.	FUZE NO.	FUZE SETTING	DMID FUNCTION	S&A FUNCTION	REMARKS
943	1	Super Quick	Yes	Yes	Plunger Stuck in Down Position
944	2		-	-	Not Recovered
945	3		-	-	Not Recovered
946	4		Yes	Yes	Firing Pin in Start Position
947	5				
948	6				Firing Pin in Start Position
949	7				
950	8				
951	9				
952	10				
953	11				
954	12				
955	13				
956	14				
957	15				
958	16				
959	17				
960	18				
961	19				
962	20				
963	21				
964	22				
965	23				
966	24				
967	25				
968	26				
969	27				
970	28	Super Quick	Yes	Yes	

ROUND NO.	FUZE NO.	FUZE SETTING	DMID FUNCTION	S&A FUNCTION	REMARKS
971	29	Super Quick	Yes	Yes	
972	30				
973	31				
974	32				
975	33				
976	34				
977	35	Super Quick	Yes	Yes	
978	36	Delay	-	-	Not Recovered
979	37		Yes	Yes	
980	38		Yes	Yes	
981	39		-	-	Not Recovered
982	40		Yes	Yes	
983	41		Yes	Yes	
984	42		-	-	Not Recovered
985	43		-	-	Not Recovered
986	44		Yes	Yes	
987	45		Yes	Yes	
988	46		-	-	Not Recovered
989	47		Yes	Yes	
990	48		Yes	Yes	
991	49		-	-	Not Recovered
992	50		Yes	Yes	
993	51		-	-	Not Recovered
994	52		Yes	Yes	
995	53		Yes	Yes	
996	54		-	-	Not Recovered
997	55		-	-	Not Recovered
998	56		-	-	Not Recovered
999	57	Delay	-	-	Not Recovered

ROUND NO.	FUZE NO.	FUZE SETTING	DMID FUNCTION	S&A FUNCTION	REMARKS
1000	58	Delay	Yes	Yes	Not Recovered
1001	59		-	-	Not Recovered
1002	60		Yes	Yes	
1003	61		Yes	Yes	
1004	62		Yes	Yes	
1005	63		Yes	Yes	
1006	64		Yes	Yes	
1007	65		Yes	Yes	
1008	66		Yes	Yes	
1009	67		Yes	Yes	
1010	68			No	Fuze Heavily Damaged
1011	69		Yes	Yes	
1012	70	Delay	-	-	Not Recovered

PHASE II

3.4 ENRIRONMENTAL TESTS

Parts Ordered for 1000 Units

100 Units made for Ballistic Tests

32 Units made for Environmental & Sensitivity Tests.

Assemblies contained the following:

Zinc Lie Cast Plungers with Minor Design Changes.

New Design Housing & Cover.

Modified Slider & Firing Pin Holder to Accomodate New Housing.

New Springs for Arming Level of 1700 RPM and

Non Arming Level of 1100 RPM.

One (1) Piece Construction Detent Lock

All Assemblies were Tested in the Same Manner as Phase I.

PHASE II

ENVIRONMENTAL TESTS

a) JOLT TEST - QTY 5 UNITS

Arming & Non-Arming Test - Acceptable

Sensitivity

Unit No.	Function Drop Height (in.)		
	4 1/2	5 1/2	6 1/2
1	Yes	-	-
2	Yes	-	-
3	Yes	-	-
4	No	No	No
5	No	Yes	-

Failure Analysis: Unit No. 4 when Plunger was Fully Depressed would not fire, no cause found.

b) JOLT & JUMBLE TEST - QTY 5 UNITS

Arming & Non-Arming After Test,

Units 8, 9 & 10 would not Arm

Sensitivity

6, 7 } Did not Function After 3 Drops

8, 9, 10 } Did not Arm After Test
Spin Detents were Jammed.

c) TRANSPORTATION VIBRATION - QTY. 5 UNITS ARMING & NON ARMING TESTS - ACCEPTABLE

Sensitivity

Unit No.	Function Height (in.)		
	4 1/2	5 1/2	6 1/2
11	Yes	-	-
12	Yes	-	-
13	Yes	-	-
14	No	No	Yes
15	Yes	-	-

D) COLD TEST (-45°F) 2 UNITS, TESTED IN ARMED POSITION

Sensitivity

Unit No.	Function Height (in)	
	4 1/2	5 1/2
16	No	Yes
17	Yes	-

E) SENSITIVITY TEST (AMBIENT CONDITION) 15 UNITS

Unit No.	Function Drop Height (in.)				
	4 1/2	5 1/2	6 1/2	7 1/2	8 1/2
18	Yes				
19	Yes				
20	Yes				
21	Yes				
22	Yes				
23	Yes				
24	Yes				
25	Yes				
26	Yes				
27	Yes				
28 *	No	No	No	Yes	
29 *				Yes	
30 *				Yes	
31 *				No	Yes
32 *				Yes	

* These Units were Dropped using new M739 Fuze Bodies. The Soft Nose Caps Cushioned the Drop Force & therefore needed a Higher Drop Distance. All other Units Utilizaed Previously Used M739 Fuzes.

3.5

PHASE II
SUMMARY
YPG RESULTS

26 Feb - 2 March 1979
Zinc Plunger

Weapon	Zone	Charge	Test	Fuze Set	Test Qty	Remarks
155MM, M109A1	2	T2	8" Plywood	Delay	10	All units functioned 3-5 feet behind target
105MM, M102	5	T2	8"Plywood	Delay	10	All units functioned 3 to 5 feet behind targets
155MM, M109A1	2	HE	HQE-Pre-Release Ground Imp.	SQ	15	All units functioned on impact
155MM, M109A1	2	Inert	HQE-Pre-Release Ground Imp.	Delay	25	Units recovered One DMID did not function
155MM, M109A1	7	HE	LQE-Broaching Ground Impact	Delay	15	All units functioned
155MM, M109A1	7	Inert	LQE-Broaching Ground Impact	Delay	25	Units recovered One DMID did not function.

TABLE 1

8" PLYWOOD IMPACT TEST

155MM, M109A1, Zone 2, T2 Charge, Target-500 Feet, Fuze Set-Delay, Velocity -780 ft./sec.Quantity - 10 Units.

Round No.	Fuze No.	Function
1	70	Behind Target (3 to 5 feet)
2	66	"
3	63	"
4	17	"
5	61	"
6	10	"
7	69	"
8	5	"
9	68	"
10	67	"

8" PLYWOOD IMPACT TEST

105MM, M102, Zone 5, T2 Charge, Target - 500 Feet, Fuze Set Delay, Velocity - 1000 ft/sec.

Round No.	Fuze No.	Function
1	4	Behind Target (3 to 5 feet)
2	16	"
3	29	"
4	30	"
5	2	"
6	9	"
7	22	"
8	21	"
9	1	"
10	62	"

PRE-RELEASE TEST

155MM, M109A1, Zone 2, HE Charge, QE-1050 MILS, Ground Impact, Fuze Set-SQ, Velocity - 780 ft/sec, Qty, 15 Units.

Round No.	Fuze No.	Function
1	46	High Order on Impact
2	88	"
3	73	"
4	39	"
5	89	"
6	87	"
7	86	"
8	34	"
9	26	"
10	77	"
11	72	"
12	37	"
13	23	"
14	25	"
15	75	"

PRE-RELEASE TEST

155MM, M109A1, Zone 2, Inert, QE-1050 MILS, Ground Impact for Recovery, Fuze Set-Delay, Velocity -780 ft/sec, Quantity - 25 Units.

Round No.	Fuze No.	Recovered
1	11	Not Recovered
2	12	Functioned (S&A Armed, Det Pierced)
3	13	"
4	6	"
5	14	"
6	15	Not Recovered
7	8	Functioned (S&A Armed, Det. Pierced)
8	5	"
9	29	"
10	10	"
11	16	"
12	4	"
13	17	"
14	3	Not Recovered
15	45	"
16	7	Functioned (S&A Armed, Det. Pierced)
17	19	Did not function (S&A Armed, Det. not Pierced)
18	20	Not Recovered
19	32	"
20	31	Functioned (S&A Armed, Det. Pierced)
21	30	"
22	22	"
23	2	"
24	26	"
25	27	Not Recovered

BROACHING TEST

155MM, M109A1, Zone 7, HE Loaded, QE-310 MILS, Ground Impact, Fuze Set-Delay, Velocity - 1850 ft/sec., Quantity 15 Units.

Round No.	Fuze No.	Function
1	27	High Order on Initial Impact
2	37	"
3	38	"
4	31	"
5	35	"
6	39	"
7	33	"
8	64	"
9	74	"
10	36	"
11	48	"
12	32	"
13	40	"
14	28	"
15	41	"

BROACHING TEST

155MM, M109A1, Zone 7, Inert, QE-310 MILS, Ground Impact for Recovery, Fuze Set-Delay, Velocity - 1850 ft/sec Quantity - 25 Units.

Round No.	Fuze No.	Recovered
1	28	Functioned (S&A Armed, Det. Pierced)
2	47	"
3	46	"
4	49	"
5	41	"
6	42	Not Recovered
7	21	S&A Armed-DMID Firing Pin did not Release
8	50	Functioned (S&A Armed, Det. Pierced)
9	32	"
10	39	"
11	31	"
12	38	"
13	27	"
14	40	"
15	48	"
16	44	"
17	43	"
18	25	"
19	23	"
20	24	"
21	34	Functioned (S/A Armed, Det. Pierced)
22	33	"
23	37	"
24	36	"
25	35	"

3.6 PHASE III
ENVIORNMENTAL TESTS

Quantity 116 DMID units of current design (Assembly No. KF-87906) and Quantity 67DMID units of updated design (some parts modified to incorperate a change in assembly procedure) Assembly No KF-87906 REV A were assembled into M739 Fuzes and tested per MIL-STD-331. For Jolt & Jumble, Transportation vibration, 40 foot drop, Thermal Shock and temperature tests.

At the completion of tests, all units were spin tested for non-arming at 1100 RPM and then armed at 1700 RPM.

A sensitivity test was then performed for function by dropping each unit at a controlled height (approx. 6 1/2 inches) to simulate impact.

A summary sheet & details of each test are as follows:

SUMMARY SHEET

PHASE III

CURRENT DESIGN

TEST	CONDITION	QTY.	FUNCTION	REMARKS
JOLT & JUMBLE	COLD TEMP. 65°F	18	16	2 units did not arm
JOLT & JUMBLE	HOT TEMP. +160°F	18	18	
TV	AMBIENT	5	5	
TV	COLD - 65°F	10	10	
TV	HOT +160F	10	6	4 units did not arm
40 FT. DROP	COLD - 65°F	10	9	1 unit did not function
40 FT. DROP	HOT	10	10	
40 FT. DROP	AMBIENT	5	5	
5 FT. DROP	COLD - 65°F	5	5	
5 FT. DROP	HOT +160°F	5	5	
5 FT. DROP	AMBIENT	10	10	
THERMAL SHOCK	-	10	8	1 Firing pin did not release 1 did not arm
	TOTALS	116	107	

PHASE III

TEST UNITS

CURRENT DESIGN

UNIT NO.		FUNCTION HEIGHT (INCHES)	REMARKS
	J & J - COLD (-65°F)	18 UNITS	
1		6 1/2	
2		6 1/2	
3		7 1/2	
4		6 1/2	
5		6 1/2	
6		15	
7		6 1/2	
8		6 1/2	
9		7 1/2	
10	Did not arm	-	
11		8 1/2	
12		7 1/2	
13		6 1/2	
14		7 1/2	
15		8 1/2	
16	Did not arm	-	
17		6 1/2	
18		15	
	J & J - HOT (+160°F) 18 UNITS		
19		6 1/2	
20		8 1/2	
21		6 1/2	
22		6 1/2	

UNIT NO.	FUNCTION HEIGHT (INCHES)	REMARKS
23	6 1/2	
24	6 1/2	
25	7 1/2	
26	6 1/2	
27	6 1/2	
28	7 1/2	
29	6 1/2	
30	6 1/2	
31	7 1/2	
32	6 1/2	
33	6 1/2	
34	6 1/2	
35	6 1/2	
36	6 1/2	
TV - AMBIENT	5 UNITS	
37	6 1/2	
38	6 1/2	
39	6 1/2	
40	6 1/2	
41	6 1/2	
TV - COLD (-65°F)	10 UNITS	
42	6 1/2	
43	8 1/2	
44	6 1/2	
45	8 1/2	
46	6 1/2	

UNIT NO.		FUNCTION HEIGHT (INCHES)	REMARKS
47		6 1/2	
48		6 1/2	
49		6 1/2	
50		6 1/2	
51		6 1/2	
	TV HOT (+160°F) 10 UNITS		
52		6 1/2	
53	Did not arm	-	
54	Did not arm	-	
55		6 1/2	
56		6 1/2	
57	Did not arm	-	
58		6 1/2	
59		6 1/2	
60	Did not arm	-	
61		6 1/2	
	40' DROP - COLD (-65°F) 10 UNITS		
62	Nose down	6 1/2	
63	Nose down	6 1/2	
64	Nose up	6 1/2	
65	Nose up	6 1/2	
66	Horiz.	6 1/2	
67	Horiz.	6 1/2	
68	45° Nose down	6 1/2	
69	45° Nose down	6 1/2	

UNIT NO.		FUNCTION HEIGHT (INCHES)	REMARKS
70	45° Nose up	6 1/2	
71	45° Nose Up	6 1/2	
	40' DROP - HOT +160°F	10 UNITS	
72		6 1/2	
73		6 1/2	
74		6 1/2	
75		6 1/2	
76		6 1/2	
77		6 1/2	
78		6 1/2	
79		6 1/2	
80		6 1/2	
81		8 1/2	
	40' DROP - AMBIENT	5 UNITS	
82		6 1/2	
83		6 1/2	
84		6 1/2	
85		6 1/2	
86		6 1/2	
	5' DROP - COLD (-65°F)	5 UNITS	
87	Nose Down	6 1/2	
88	Nose up	6 1/2	
89	Horiz.	6 1/2	
90	45° Nose down	6 1/2	
91	45° Nose up	6 1/2	

UNIT NO.		FUNCTION HEIGHT (INCHES)	REMARKS
	5' DROP - HOT (160°F)	5 UNITS	
92	Nose Down	6 1/2	
93	Nose up	6 1/2	
94	Horiz.	6 1/2	
95	45° Nose down	6 1/2	
96	45° Nose up	6 1/2	
	5' DROP - AMBIENT	10 UNITS	
97	Nose up	6 1/2	
98	"	6 1/2	
99	Nose down	6 1/2	
100	"	6 1/2	
101	Horiz.	6 1/2	
102	"	6 1/2	
103	45° Nose down	6 1/2	
104	" "	6 1/2	
105	45° Nose up	6 1/2	
106	" "	6 1/2	
	THERMAL SHOCK	10 UNITS	
107		6 1/2	
108		6 1/2	
109	Balls released (firing pin did not release)		
110	Did not arm	6 1/2	
111		6 1/2	
112		6 1/2	
113		6 1/2	
114		5 1/2	

UNIT NO.	FUNCTION HEIGHT (INCHES)	REMARKS
115	5 1/2	
116	5 1/2	

3.6.1

ENVIRONMENTAL TESTS
PHASE III
UPDATED DESIGN
SUMMARY SHEET

TEST	CONDITION		QTY	FUNCTION	REMARKS
TV	Ambient		2	1	1 Did not arm (Spin lock jammed)
TV	Cold	-65°F	5	5	
TV	Hot	+160°F	5	4	1 Did not arm
Jolt & Jumble	Cold	-65°F	5	3	1 Did not arm 1 Assembled in armed position
Jolt & Jumble	Hot	+160°F	5	0	Units assembled in armed position No Test
Jolt & Jumble	Hot	(Retest)	4	3	1 Did not fire Unit set safe
Jolt & Jumble	Ambient	(Retest)	8	7	1 Unit did not arm Spin locks jammed
40Ft. Drop	Cold	-65°F	5	5	
40Ft. Drop	Hot	+160°F	5	5	
40Ft. Drop	Ambient		2	2	
5Ft. Drop	Cold	-65°F	2	2	
5Ft. Drop	Hot	+160°F	2	2	
5Ft. Drop	Ambient		5	5	
Thermal Shock	-		5	5	
SPECIAL UNITS					
Jolt & Jumble	Cold	-65°F	3	2	1Did not arm
TV	Cold	-65°F	4	4	
		Total	67	55	

PHASE III

TEST UNITS

UPDATED DESIGN

UNIT NO.	TEST	FUNCTION HEIGHT (INCHES)
	TV-AMBIENT	
1		8 1/2"
2	Did not arm - Spin Detent Jammed	
	TV-COLD - 65°F	
3		6 1/2
4		6 1/2
5		8 1/2
6		8 1/2
7		8 1/2
	TV-HOT +160°F	
8		6 1/2
9	Did not arm - (Spin Detent)	
10		8 1/2
11		6 1/2
12		6 1/2
	J&J - COLD -65°F	
13	Did not arm (Spin detents jammed 2)	
14		8 1/2
15		8 1/2
16	Unit - fired during test - was assembled in armed position	
17		8 1/2
	J&J - HOT 160°F	
18	Unit was assembled in armed position - retest	
19	Same as Item 18	
20	Same as Item 18	
21	Did not arm	
22	Same as Item 18	

PHASE III

TEST UNITS

UPDATED DESIGN

UNIT NO.	TEST	FUNCTION HEIGHT (INCHES)
	40'DROP - COLD - 65°F	
23	Nose Down	6 1/2
24	Nose Up	6 1/2
25	Horiz.	6 1/2
26	45° Nose Up	8 1/2
27	45° Nose Down	8 1/2
	40' DROP - HOT -165°F	
28	Nose Down	6 1/2
29	Nose Up	6 1/2
30	Horiz.	8 1/2
31	45° Nose Down	8 1/2
32	45° Nose Up	8 1/2
	40' DROP - AMBIENT	
33	Nose Down	8 1/2
34	Nose Down	8 1/2
	5' DROP - COLD -65°F	
35	Nose Down	6 1/2
36	Nose Down	8 1/2
	5' DROP - HOT +165°F	
37	Nose Down	6 1/2
38	Nose Down	8 1/2
	5' DROP - AMBIENT	
39	Nose Down	6 1/2
40	Nose Up	8 1/2
41	Horiz	6 1/2
42	45° Nose Up	8 1/2
43	45° Nose Down	6 1/2

PHASE III

TEST UNITS

UPDATED DESIGN

UNIT NO.	TEST	FUNCTION HEIGHT (INCHES)
	THERMAL SHOCK -65°F & 160°F	
44		6 1/2
45		8 1/2
46		6 1/2
47		6 1/2
48		8 1/2
	J&J - RERUN - AMBIENT	
A		8 1/2
B		8 1/2
C		8 1/2
D		6 1/2
E		8 1/2
F		8 1/2
G	Did Not Arm - Spin Detents Jammed	
H		8 1/2
	J&J - HOT +160°F (RETEST)	
18	Did not fire - Unit set safe at 7" after 4 Drops	
19		6
20		5 1/2
22		6

The following tests were made on updated units (modified for improved assembly) with Zinc Die Cast Firing Pin Holder P/N KC-89493.

Jolt & Jumble Test - 8 Units 4 Hot & 4 Cold.

All Units did not function.

It was determined after this test that the Firing Pin Balls did not Release the Firing Pin. This was due to excessive force used while staking the retainer onto the firing pin holder which closed up the Firing Pin Ball Holes.

New Units were assembled and The Test Rerun as follows;

J&J, COLD TEMP. (-65°F)

Unit No.	Function Height (in.)
5	Did not arm (cent. Lock sticky)
6	7 1/2
7	6 1/2

TV CONDITIONED, COLD TEMP. (-65°F)

12	6 1/2
13	6 1/2
14	7 1/2
15	6 1/2

3.7 BALLISTIC TESTS
PHASE III

The following ballistic tests were conducted to evaluate the Final Prototype Design (Dwg. KD87906 Rev. A) under this contract.

All tests were conducted at Yuma Proving Ground using M739 Fuzes and T-2 explosive charges.

A summary and detail sheets follow.

A- Diagnostic These ground impact tests were conducted to determine unit performance at zones and elevations where previous designs experienced operational problems. (Broaching and Pre-release)

B- Sensitivity These tests were conducted to determine unit sensitivity against plywood targets using min. and max. charges and various plywood thicknesses.

C- Reliability

D- Graze

E- Penetration

3.7

SUMMARY
YUMA PROVING GROUND TEST RESULTS
PHASE III
DUAL MODE IMPACT DELAY DEVICE BALLISTIC TESTS USING M739 FUZES

Test No.	Weapon	Zone	Charge	Test	Fuze Setting	Qty	Remarks
				Diagnostic			
A1	175mm	1	HE	Ground Impact	Delay	10	All Units Functioned
				Sensitivity			
B1	105mm	1	T2		Delay	15	All Fire Level 3" THK
B2	105mm	5	T2	Langlie Test on Plywood	Delay	14	All Fire Level 3"THK
B3	105mm	7	T2	Targets of Various	Delay	18	All Fire Level 3 1/2 THK
B4	155mm	2	T2	Thickness	Delay	15	All Fire Level 4 1/2" THK
B5	155mm	7	T2	Distance 500 ft.	Delay	17	All Fire Level 6 1/2"THK
B6	175mm	1	T2		Delay	16	All Fire Level 6 1/2"THK
B7	175mm	3	T2		Delay	15	All Fire Level 8 1/2" THK
B8	8 inch	1	T2		Delay	15	All Fire Level 6" THK
B9	8 inch	7	T2		Delay	15	All Fire Level 6 1/2 THK
				Langlie Retest			
B10	105mm	1	T2	at -65°F	Delay	15	All Fire Level 3 1/2"THK
B11	105mm	7	T2	at +155°F	Delay	15	All Fire Level 4" THK
B12	175mm	3	T2	Ambient	Delay	15	All Fire Level 3 1/2" THK

NOTE: Charts plotting above Langlie Tests are shown on the following pages.

SHEET 1 of 3

Test No.	Weapon	Zone	Charge	Test	Fuze Setting	Qty	Remarks
				Reliability Tests			
C1	155mm	7	T2	Ground Impact Cold Temp. -50°F	Delay	30	1 Possible DUD
C2	175mm	3	T2	Ground Impact Cold Temp-50°F	Delay	10	All Units Functioned
C3	175mm	3	T2	Ground Impact Hot Temp 145°F	Delay	10	All Units Functioned
C4	105mm	7	T2	Ground Impact Cold Temp-50°F	Delay	15	1 Possible DUD
C5	105mm	7	T2	Ground Impact TV conditioned	Delay	15	All Units Functioned
C6	155mm	2	T2	6 Inch Plywood Target at 45° Angle to Gun	Delay	15	1 did not Function on target but functioned on impact with gnd.
C7	105mm	5	T2	4 inch plywood target at 45° angle to gun	Delay	15	1 did not Function on Target but functioned on impact with gnd.
C8	155mm	2	T2	HQE ground impact ambient temp.	Delay	30	All units functioned
C9	155mm	2	T2	HQE ground impact TV conditioned	Delay	25	All units functioned
C10	105mm	7	T2	LQE ground impact ambient temp	SQ	40	All units functioned

SHEET 2 of 3

Test No.	Weapon	Zone	Charge	Test	Fuze Setting	Qty	Remarks
C11	105mm	1	T2	4 in. Thk plywood at 500 ft. Hot temp +145°F	Delay	10	9/10 Functioned 3-5 feet behind target 1/10 Functioned on gnd. impact
C12	105mm	1	T2	4 in. Thk plywood at 500 ft. Cold temp -50°F	Delay	10	1/10 missed target 4/10 Functioned 3-5 Ft behind target 5/10 Functioned on gnd. impact
C13	105mm	1	T2	4 in Thk plywood at 500 ft. TV conditioned	Delay	10	1/10 missed target 8/10 functioned 3-5 ft. behind target 1/10 functioned on gnd. impact
C14	105mm	7	T2	4 1/2 in. thk plywood at 500 ft. Hot temp +145°F	Delay	10	4/10 missed target 3/10 functioned 3-5ft behind target 3/10 functioned on gnd. impact
				Graze Tests			
D1	105mm	1	T2	Ground impact 500 to 850 feet	Delay	25	23/25 graze functioned. Approx. graze angle 2° 2/25 functioned on 2nd impact
D2	105mm	7	T2	Ground impact 300 to 600 feet	Delay	25	20/25 graze functioned. Approx. graze angle 2° 5/25 functioned on 2nd impact
				Penetration Tests has not been fired			

SHEET 3 of 3

3.7

A DIAGNOSTIC

A-1 175mm, Zone 1 - 15 inert rounds - to be recovered.

Cancelled

A-2 175mm, Zone 1, Set Delay - 10 rounds fired H. E., ground impact

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
271	358	1780	Yes	75 - 80 sec. flight time
272	360	1794	"	
273	356	1787	"	Elevation 900 mils
274	355	1784	"	
275	457	1781	"	
276	451	1784	"	
277	452	1786	"	
278	453	1766	"	
279	455	1780	"	
280	456	1781	"	

B SENSITIVITY
Langlie type test using plywood targets at 500 feet distance and fired horizontal.

B-1 Weapon - 105mm. Zone 1, Set Delay

Fuze No.	Plywood Thickness	Function	Remarks
193	5	Yes	
194	3 1/2	"	
195	2 1/2	"	
196	2	"	
197	1/2	No	
198	1/2	"	
199	1 1/2	"	
200	3 1/2	Yes	
41	2 1/2	"	
42	1 1/2	No	
43	2	"	
44	2 1/2	"	
45	3 1/2	Yes	
46	3	"	
47	1 1/2	No	

B-2 105mm, Zone 5, Velocity approx. 1068 ft/sec.

Round No.	Fuze No.	Plywood Thickness	Function	Remarks
	3	5	Yes	
	4	3 1/2	"	
	5	2 1/2	No	
	6	2 1/2	Yes	
	7	1/2	No	
	8	1 1/2	"	
	9	3	Yes	
	10	2	No	
	11	2	No Test	
	12	2	No	
	13	2 1/2	"	
	14	3 1/2	Yes	
	15	3	"	
	16	2 1/2	No	

B-3 105mm, Zone 7

Round No	Fuze No.	Plywood Thickness	Function	Remarks
	31	5	Yes	
	32	3 1/2	"	
	33	2 1/2	No	
	34	3	"	
	35	4	Yes	
	36	3 1/2	"	
	37	3	No	
	38	3 1/2	Yes	
	39	3	No	
	40	3 1/2	Yes	
	113	3	No	
	114	3 1/2	No Test	Hit top of frame on target
	115	3 1/2	Yes	
	116	3	No Test	
	117	3	Yes	
	118	2 1/2	No Test	
	119	2 1/2	No	
	120	3	"	

B-4 155mm, Zone 2, Velocity approx. 750 ft/sec.

Round No.	Fuze No.	Plywood Thickness	Function	Remarks
	65	4	No	
	66	6	Yes	
	67	5	"	
	68	3 1/2	"	
	69	2 1/2	No	
	70	3	Yes	
	71	2 1/2	No	
	72	3	"	
	49	5 1/2	Yes	
	50	4	No	
	51	5	Yes	
	52	4 1/2	"	
	53	3	No	
	54	3 1/2	"	
	55	5 1/2	Yes	

B-5 155mm, Zone 7, Qty. 17, Velocity 1857 ft/sec.

Round No.	Fuze No.	Plywood Thickness	Function	Remarks
	56	4	No	
	57	6	"	
	58	8	Yes	
	59	7	"	
	60	4 1/2	"	
	61	3	No	
	62	4	"	
	63	5 1/2	Yes	
	64	4 1/2	No Test	Hit frame
	73	4 1/2	No	
	74	5	"	
	75	6 1/2	Yes	
	76	6	"	
	77	4	"	
	78	3 1/2	No Test	Missed target
	79	3 1/2	Yes	
	80	2 1/2	No	

B-6 175mm, Zone 1, Qty. 16, Velocity 1675 ft/sec.

Round No.	Fuze No.	Plywood Thickness	Function	Remarks
193				
194	266	7 in.	Yes	
195	267	4 1/2	No	
196	268	6	Yes	
197	269	5	No	
198	270	5 1/2	"	
199	271	8 1/2	Yes	
200	272	7	"	
201	251	4 1/2	No	
202	252	6	"	
203	253	9	Yes	
204	254	7 1/2	"	
205	177	5	No	
206	178	6	Yes	
207	179	5 1/2	No	
208	180	6	Yes	

B-7 175mm, Zone 3, Qty. 15, Velocity 3000 ft/sec.

Round No.	Fuze No.	Plywood Thickness	Function	Remarks
	90	8	Yes	
	95	8	No	
	97	11	Yes	
	98	9 1/2	"	
	99	6	"	
	100	4	"	
	101	2	No	
	102	3	Yes	
	103	2 1/2	"	
	104	2	"	
	89	1/2	"	
	94	1/2	No	

B-8 8-inch Gun, Zone 1, Qty. 15

Round No.	Fuze No.	Plywood Thickness	Function	Remarks
	17	5	No	
	18	6 1/2	Yes	
	19	6	"	
	20	4	No	
	21	5	"	
	22	6	Yes	
	23	5 1/2	No	
	24	6	Yes	
	121	5 1/2	No	
	122	6	Yes	
	123	5 1/2	No	
	124	6	Yes	
	125	5 1/2	No	
	126	6	Yes	
	127	5 1/2	No	

B-9 8-inch Gun, Zone 7, Qty. 15

Round No.	Fuze No.	Plywood Thickness	Function	Remarks
	128	7	Yes	
	161	5	"	
	162	3 1/2	No	
	163	4	"	
	164	6	"	
	165	8 1/2	Yes	
	166	5 1/2	No	
	167	6	Yes	
	168	5 1/2	No	
	169	6	"	
	170	7	Yes	
	171	6 1/2	"	
	172	6	No	
	173	6 1/2	Yes	
	174	6	No	

B-10 105mm, Zone 1, -65°, Qty. 15

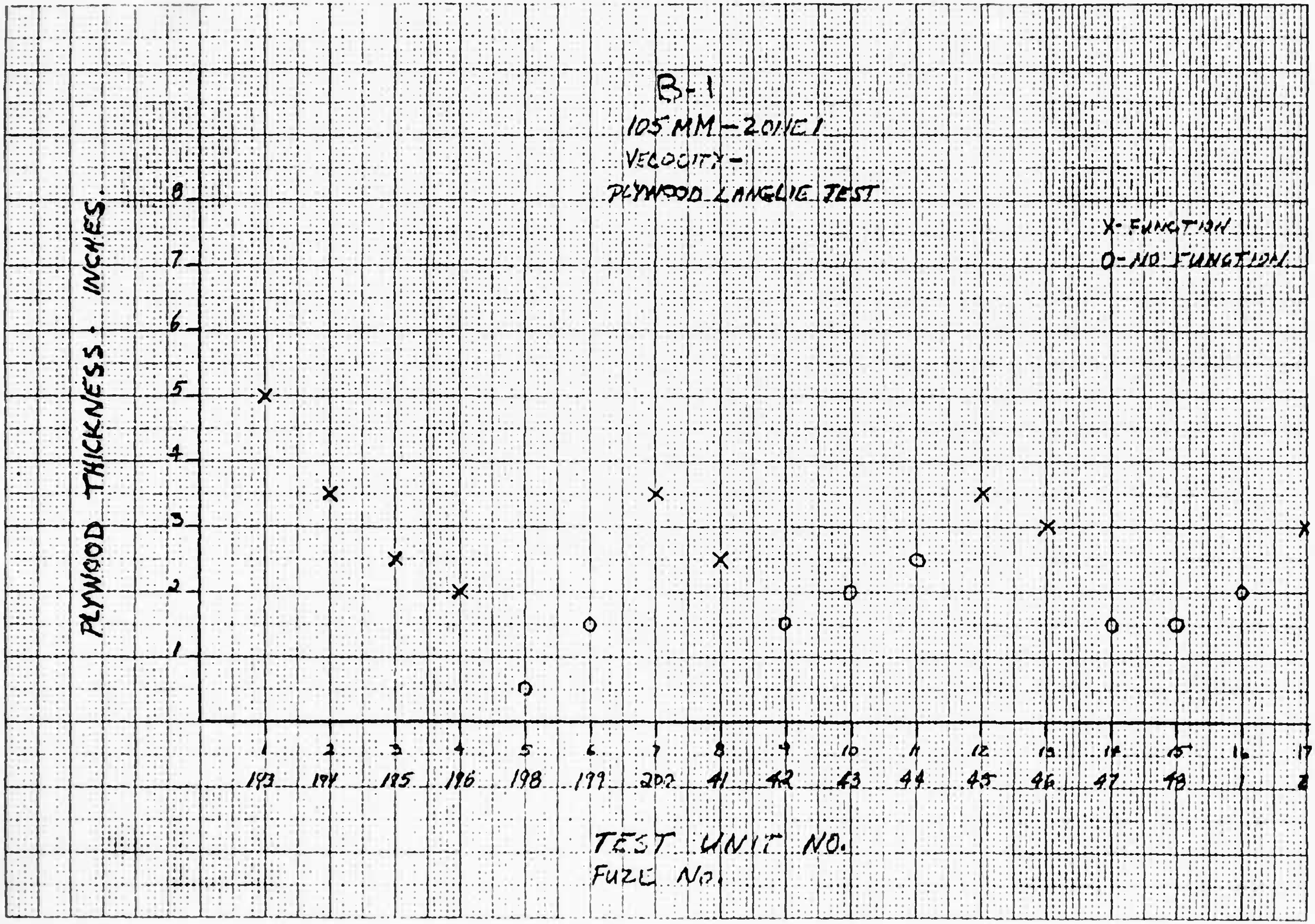
Round No.	Fuze No.	Plywood Thickness	Function	Remarks
	420	5	Yes	
	421	3 1/2	Yes	
	419	2 1/2	No	
	422	3	Yes	
	423	2 1/2	No	
	424	3	Yes	
	425	2 1/2	No	
	426	3	No	
	427	5 1/2	Yes	
	432	4	Yes	
	428	3	Yes	
	429	2 1/2	No	
	433	3	No	
	434	5 1/2	Yes	
	430	4	Yes	

B-11 105mm, Zone 7, +155°F, Qty. 15

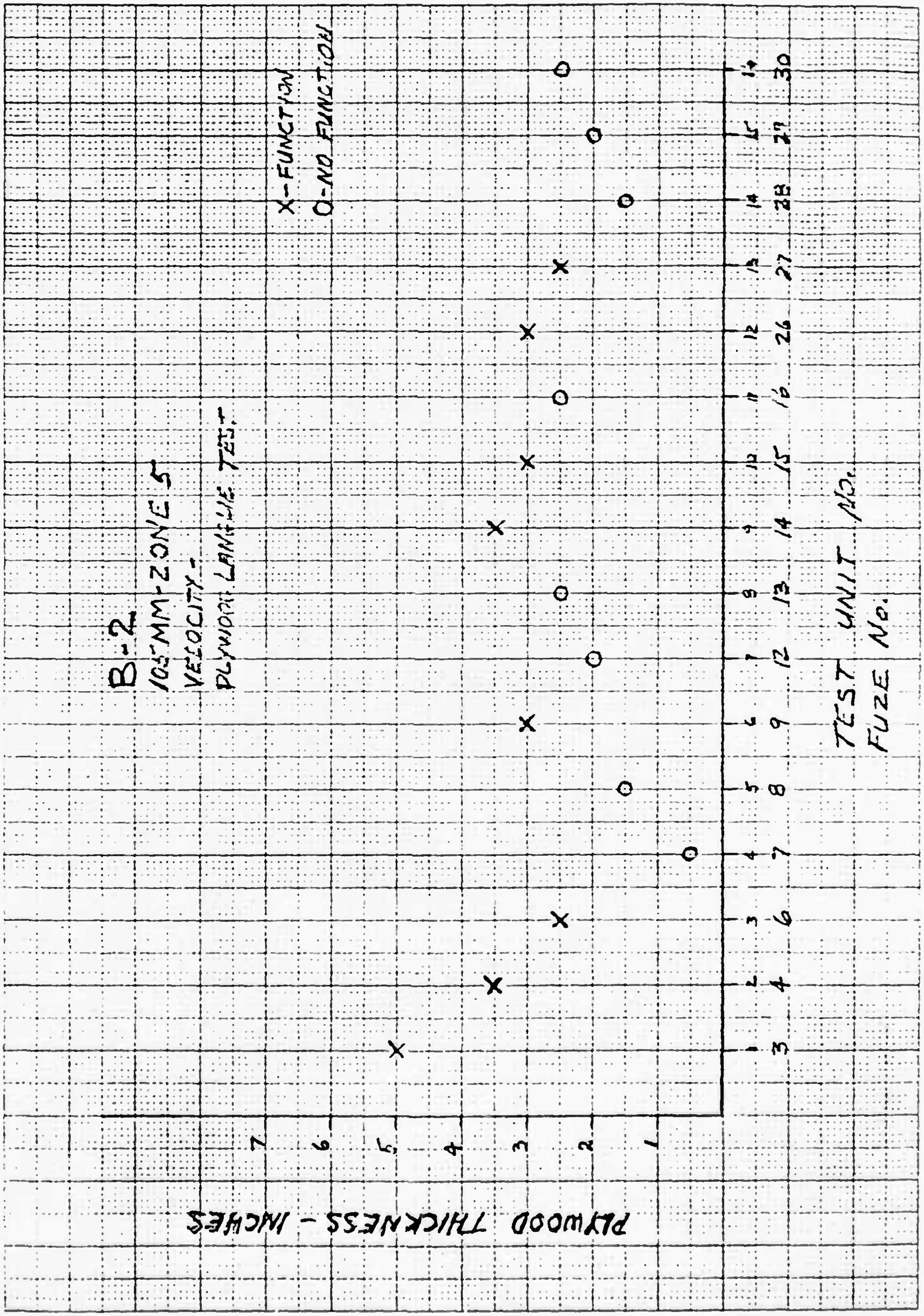
Round No.	Fuze No.	Plywood Thickness	Function	Remarks
	431	5	No	
	396	6 1/2	Yes	
	397	6	Yes	
	399	4	Yes	
	400	3	Yes	
	401	2	No	
	402	2 1/2	No	
	459	5	Yes	
	461	4	Yes	
	462	3	Yes	
	463	2	No	
	464	2 1/2	No	
	465	3	No	
	466	5	Yes	
	460	3 1/2	Yes	

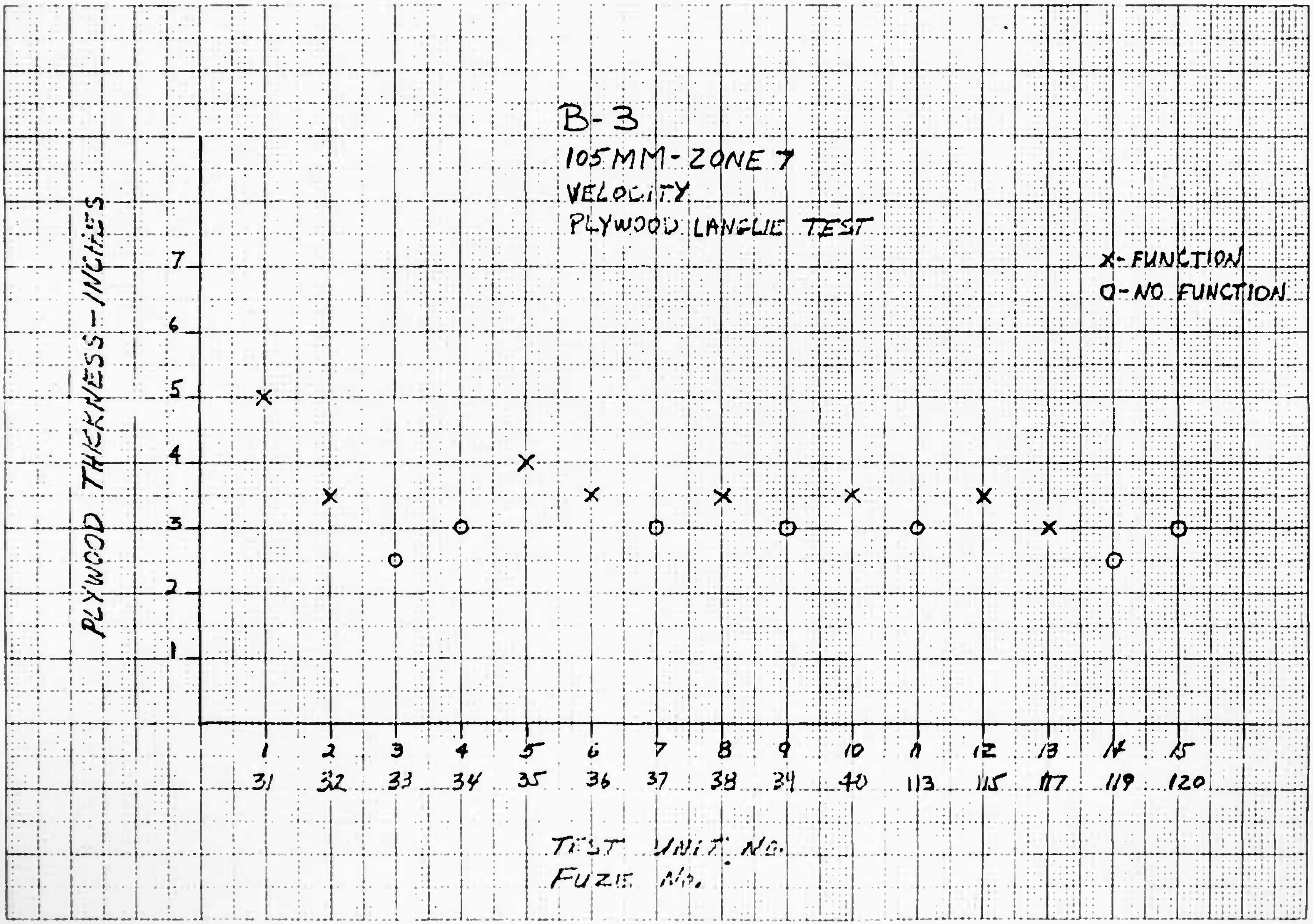
B-12 175mm, Zone 3, Ambient, Qty. 15

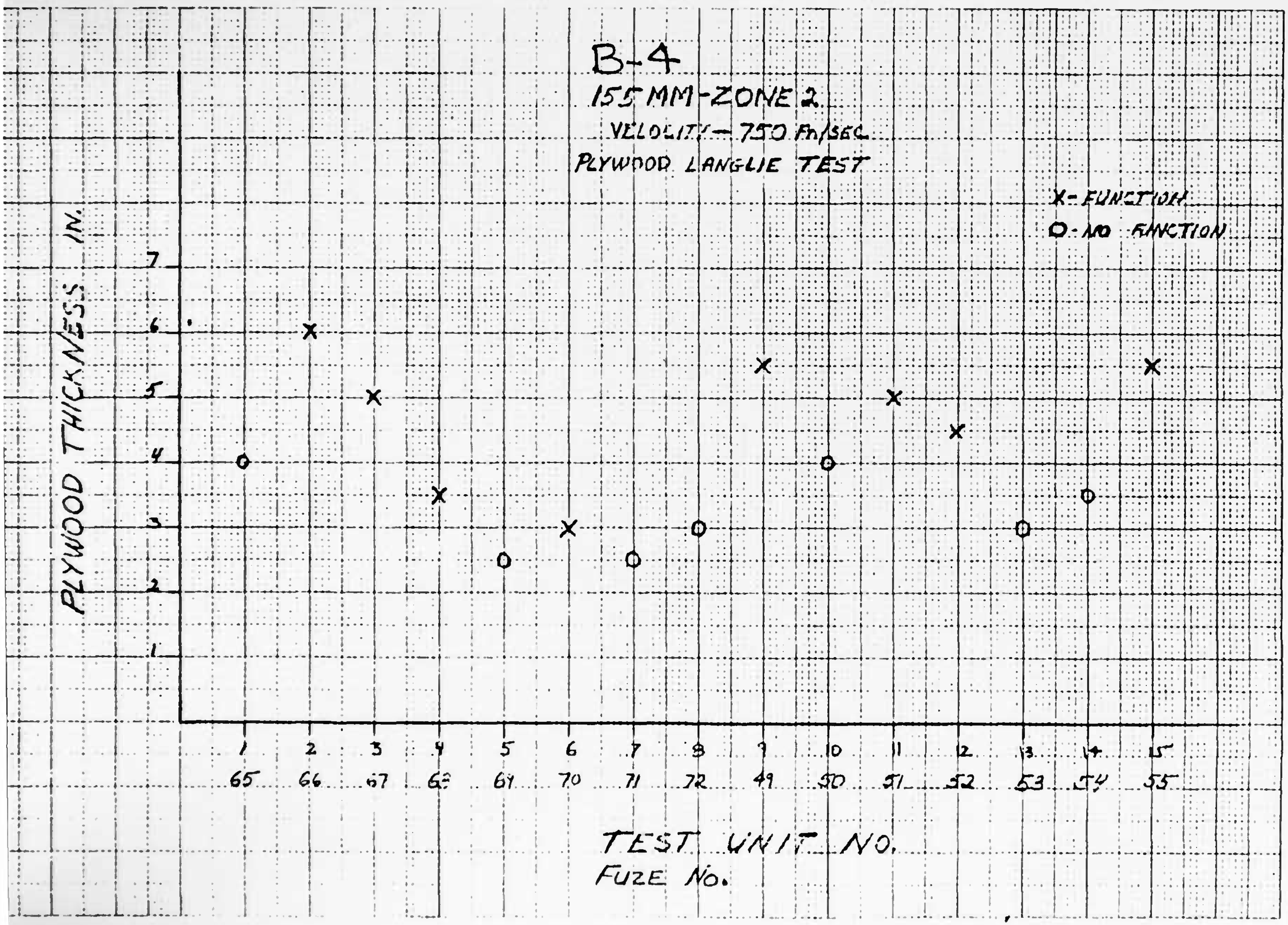
Round No.	Fuze No.	Plywood Thickness	Function
	435	3	Yes
	436	1 1/2	No
	437	2	No
	438	4	No
	439	5	Yes
	440	4 1/2	Yes
	441	2 1/2	No
	442	3 1/2	Yes
	482	3	Yes
	398	1 1/2	No
	412	2	Yes
	413	1 1/2	No
	414	2	No
	395	4	Yes
	416	3	No



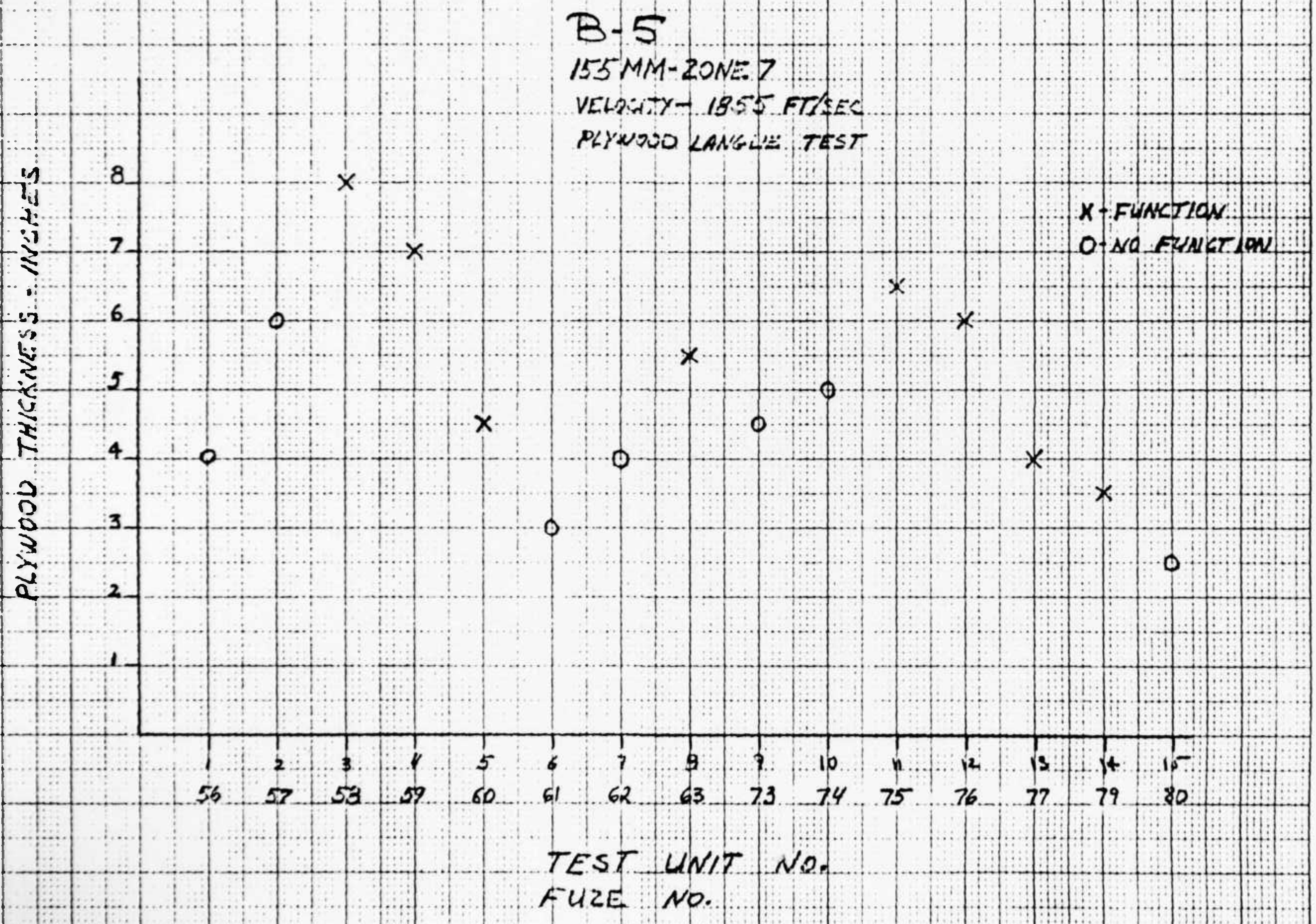
B-1
105 MM - ZONE 1
VELOCITY -
PLYWOOD LANGLIE TEST
X - FUNCTION
O - NO FUNCTION
PLYWOOD THICKNESS - INCHES.
8
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
193 194 195 196 198 199 202 41 42 43 44 45 46 47 48 1 2
TEST UNIT NO.
FUZE NO.

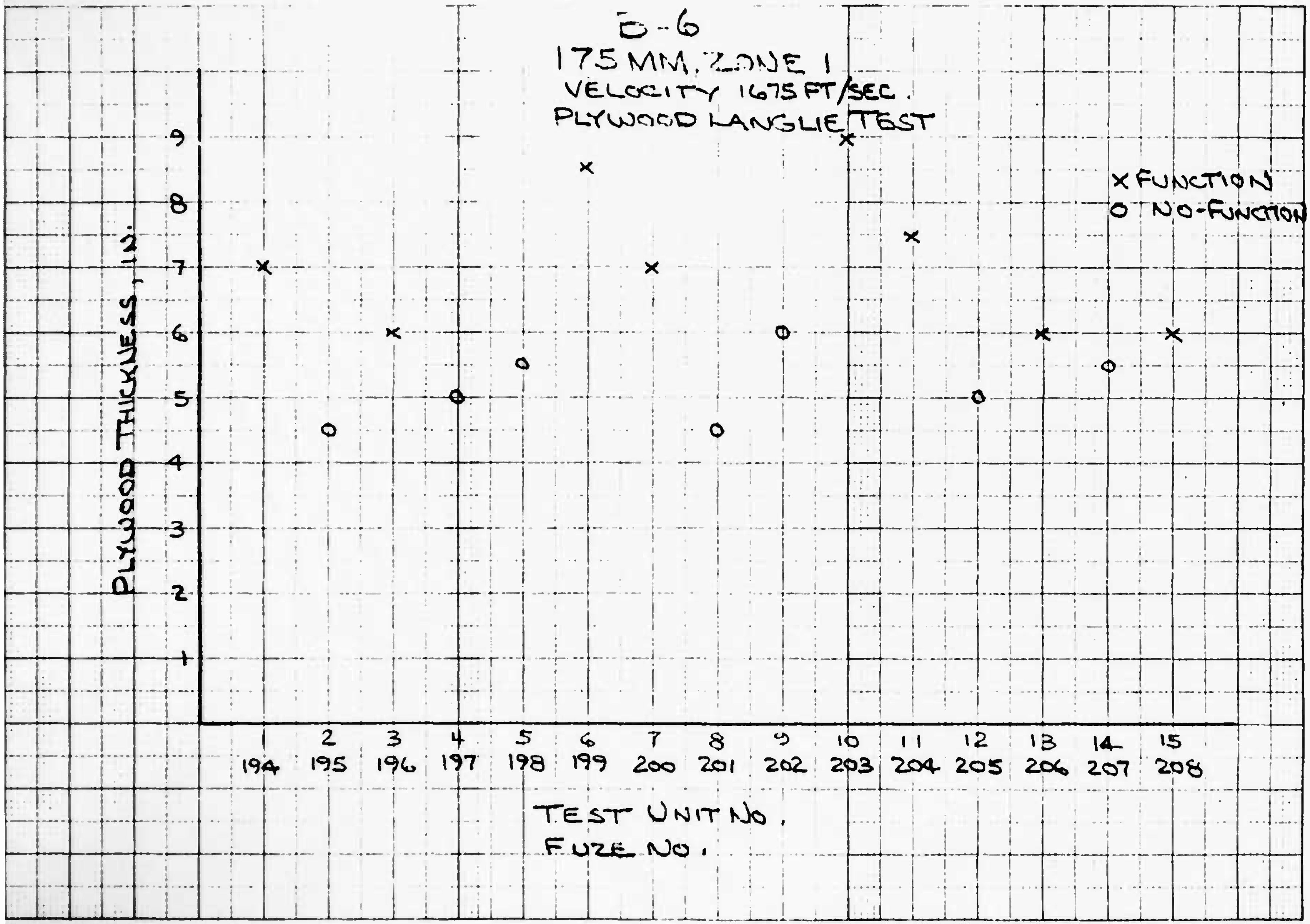

B-2
105MM-ZONE 5
VELOCITY -
X-FUNCTION
O-NO FUNCTION
TEST UNIT NO.
FUZE NO.
PLYWOOD THICKNESS - INCHES


B-3
105MM-ZONE 7
VELOCITY
PLYWOOD LANGLIE TEST
X-FUNCTION
O-NO FUNCTION
PLYWOOD THICKNESS-INCHES
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
31 32 33 34 35 36 37 38 39 40 113 115 117 119 120
TEST UNIT NO.
FUZE NO.

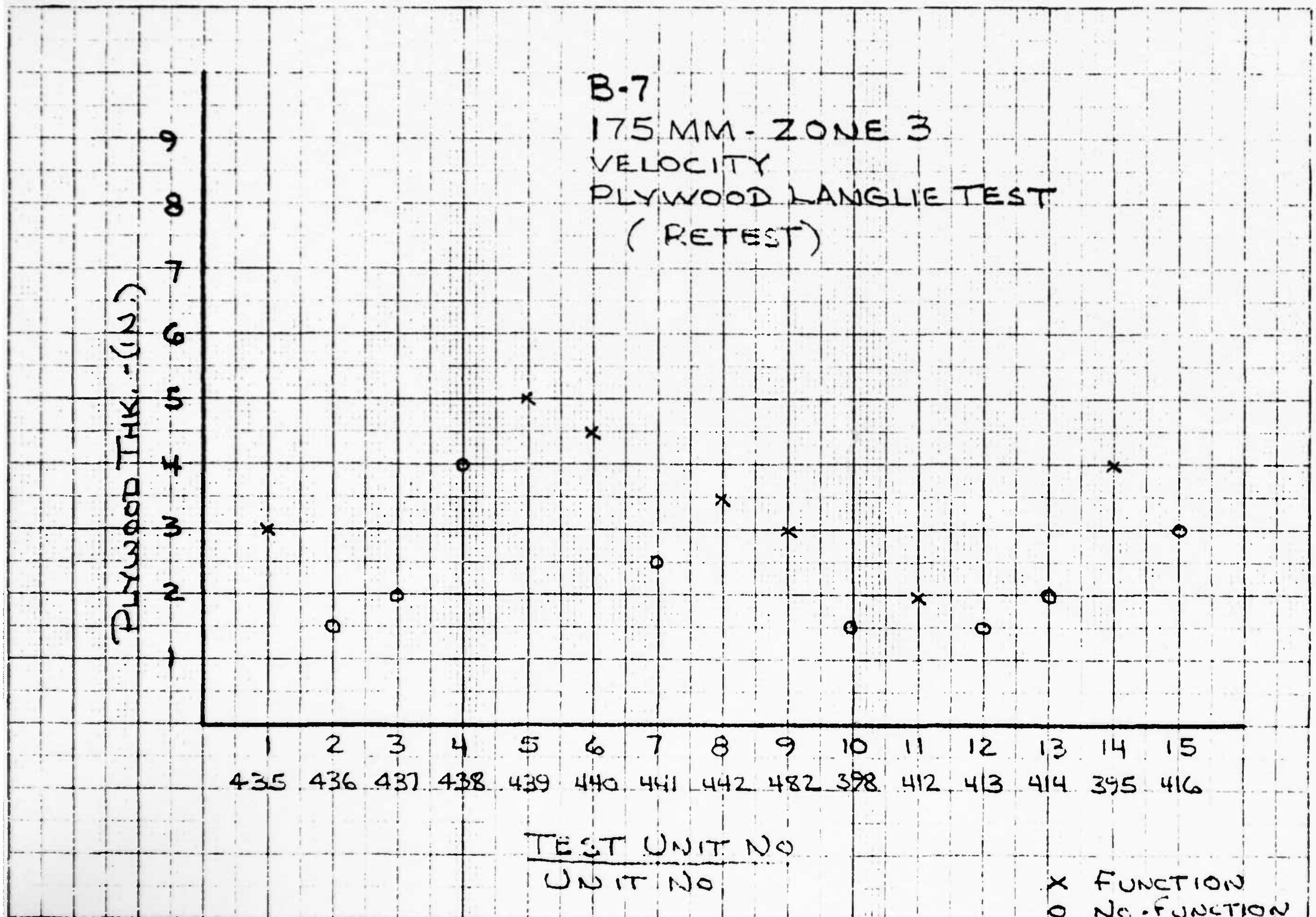


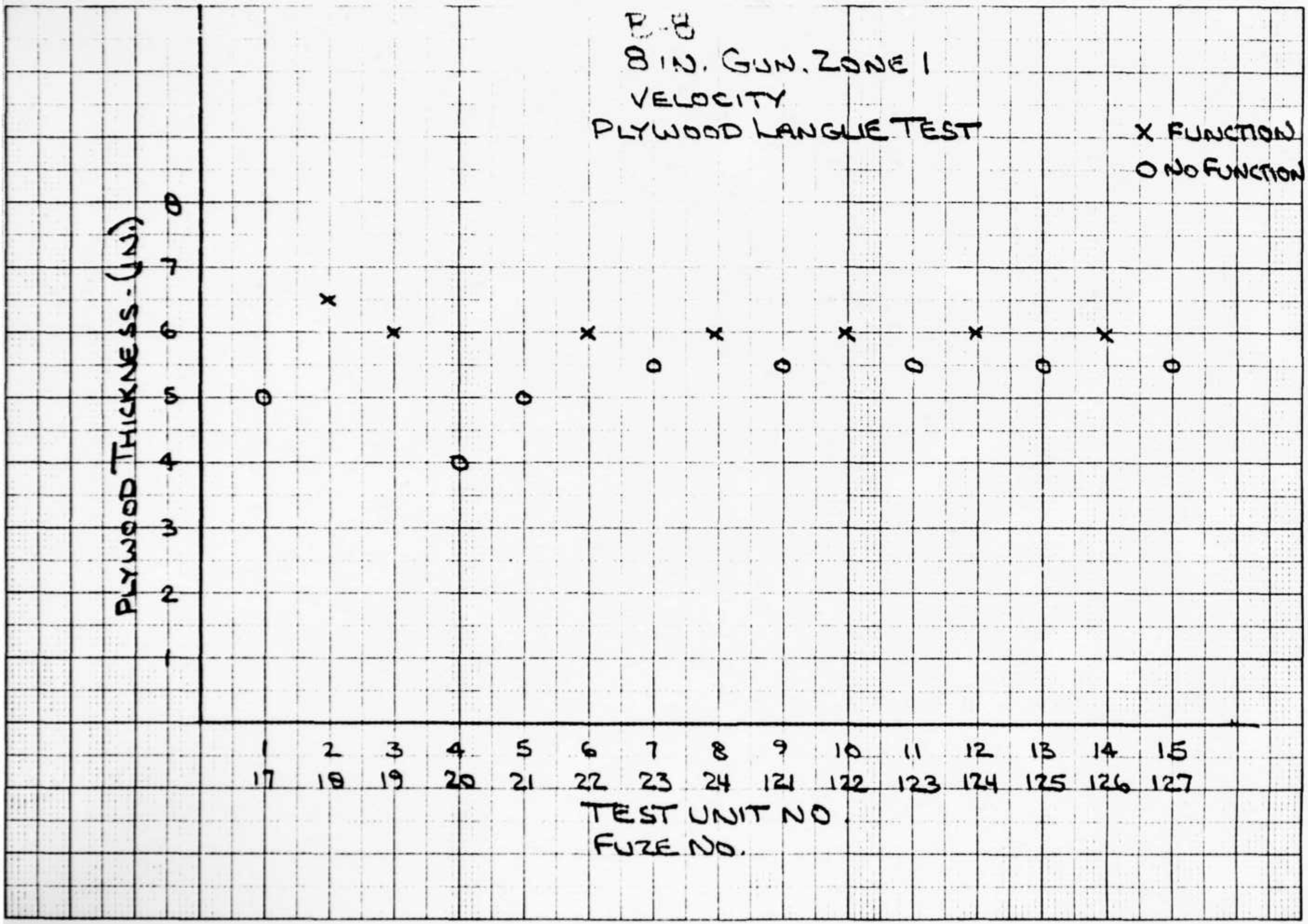
EUGENE DIETZGEN CO.
B-4
155 MM-ZONE 2
VELOCITY — 750 Ft/SEC
PLYWOOD LANGLIE TEST
X - FUNCTION
O - NO FUNCTION
PLYWOOD THICKNESS IN.
1
2
3
4
5
6
7
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
65 66 67 68 69 70 71 72 49 50 51 52 53 54 55
TEST UNIT NO.
FUZE No.


B-5
155 MM-ZONE 7
VELOCITY - 1855 FT/SEC
PLYWOOD LANGLE TEST
X - FUNCTION
O - NO FUNCTION
PLYWOOD THICKNESS - INCHES
1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
56 57 53 59 60 61 62 63 73 74 75 76 77 79 80
TEST UNIT NO.
FUZE NO.

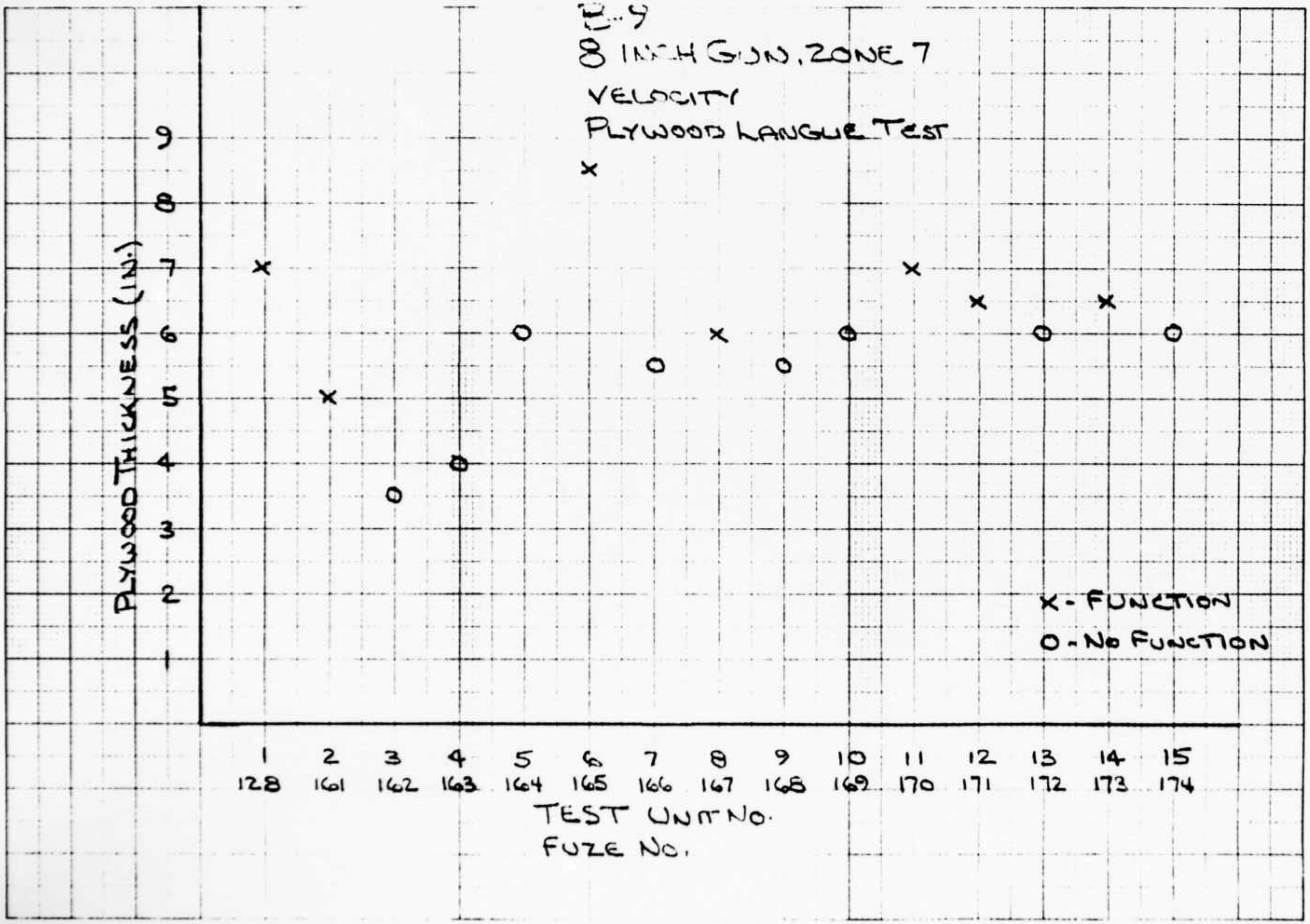


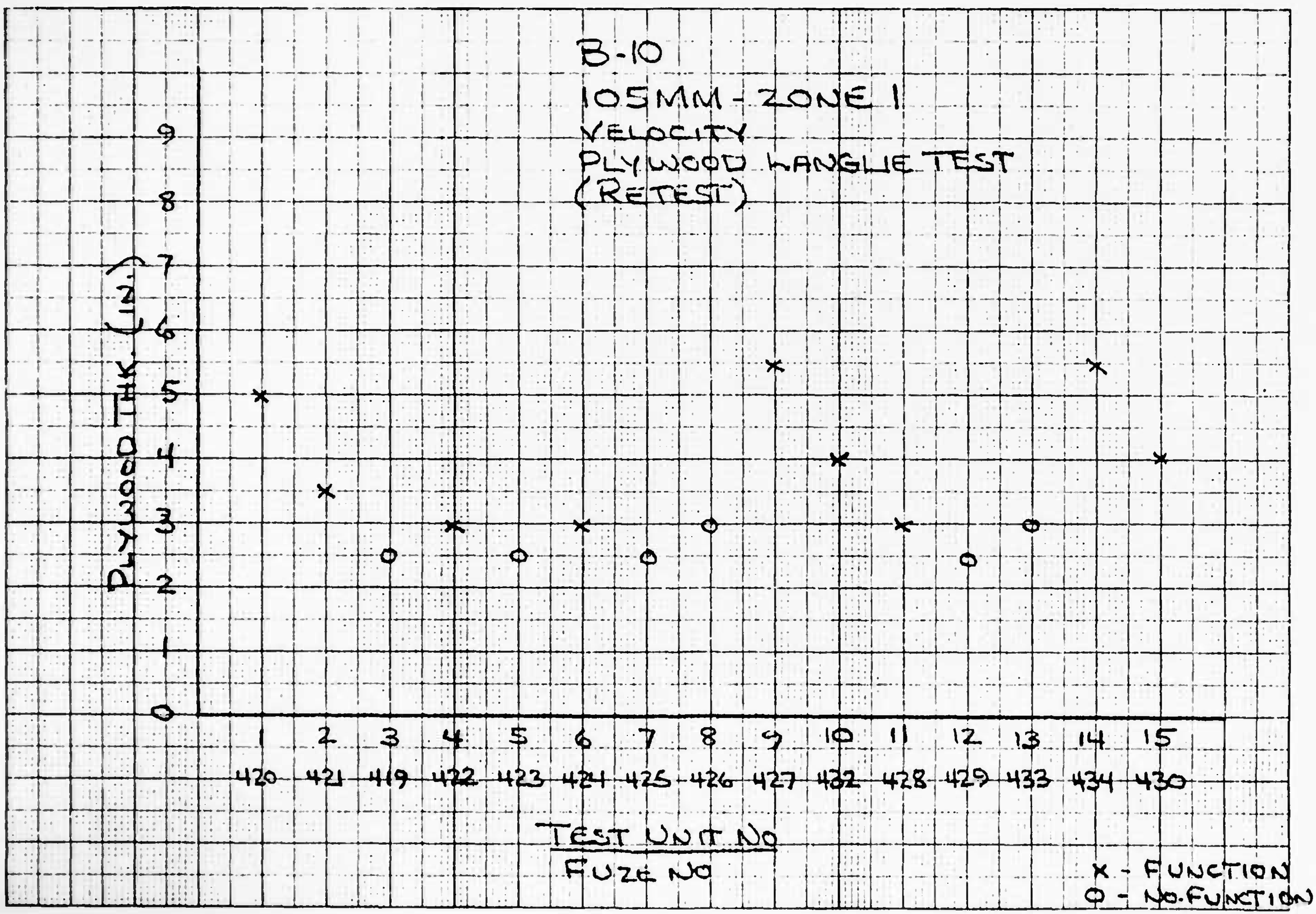
D-6
175 MM, ZONE 1
VELOCITY 1675 FT/SEC.
PLYWOOD LANGLIE TEST
X FUNCTION
O NO-FUNCTION
PLYWOOD THICKNESS, IN.
9
8
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
194 195 196 197 198 199 200 201 202 203 204 205 206 207 208
TEST UNIT NO.
FUZE NO.


B-7
175 MM - ZONE 3
VELOCITY
PLYWOOD LANGLIE TEST
(RETEST)
PLYWOOD THK. - (IN.)
9
8
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
435 436 437 438 439 440 441 442 482 398 412 413 414 395 416
TEST UNIT NO
UNIT NO
X FUNCTION
O NO-FUNCTION

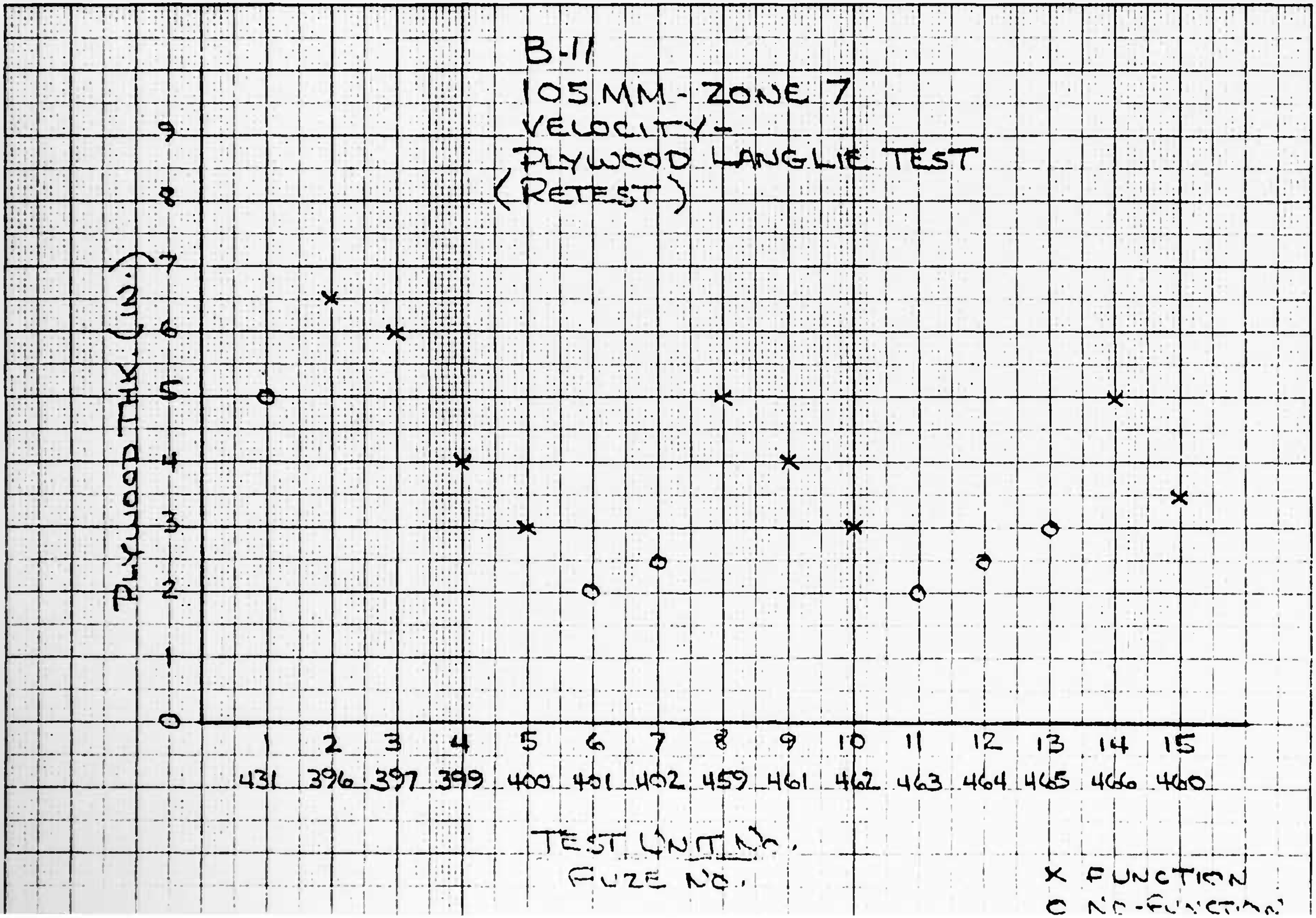


B-8
8 IN. GUN. ZONE I
VELOCITY
PLYWOOD LANGLIE TEST
X FUNCTION
O NO FUNCTION
PLYWOOD THICKNESS - (IN.)
1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
17 18 19 20 21 22 23 24 121 122 123 124 125 126 127
TEST UNIT NO.
FUZE NO.

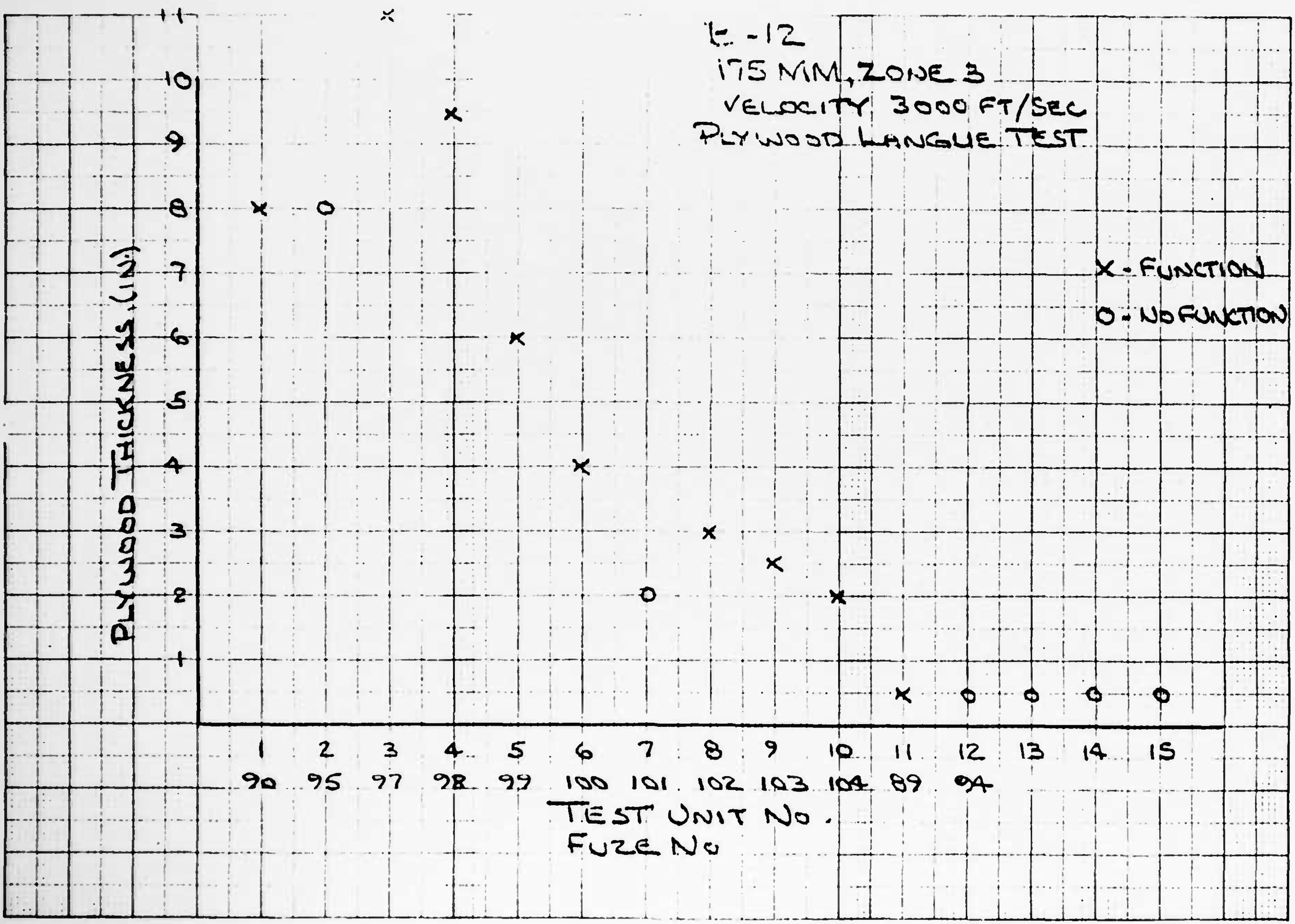

8 INCH GUN, ZONE 7
VELOCITY
PLYWOOD LANGUE TEST
PLYWOOD THICKNESS (IN.)
9
8
7
6
5
4
3
2
1
X - FUNCTION
O - NO FUNCTION
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
128 161 162 163 164 165 166 167 168 169 170 171 172 173 174
TEST UNIT NO.
FUZE NO.



B-10
105MM - ZONE 1
VELOCITY
PLYWOOD LANGLIE TEST
(RETEST)
PLYWOOD THK. (IN.)
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
420 421 419 422 423 424 425 426 427 432 428 429 433 434 430
TEST UNIT NO
FUZE NO
X - FUNCTION
O - NO FUNCTION



B-11
105 MM - ZONE 7
VELOCITY -
PLYWOOD LANGLIE TEST
(RETEST)
PLYWOOD THK. (IN.)
0
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
431 396 397 399 400 401 402 459 461 462 463 464 465 466 460
TEST UNIT NO.
FUZE NO.
X FUNCTION
O NO-FUNCTION


E-12
175 MM, ZONE 3
VELOCITY 3000 FT/SEC
PLYWOOD LANGUE TEST
X - FUNCTION
O - NO FUNCTION
PLYWOOD THICKNESS, (IN.)
1 2 3 4 5 6 7 8 9 10 11
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
90 95 97 98 99 100 101 102 103 104 89 94
TEST UNIT NO.
FUZE NO

C RELIABILITY TESTS

Ground impact and plywood tests at ambient, temperature conditioned, and TV conditioned.

All fuzes set delay except where noted and T-2 charges used.

C-1 155mm, Zone 7, LQE 83-5° azimuth, 500 mils elevation, cold temperature conditioned at -50°F, quantity 30 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
1108	512	1865	Yes	*
1109	508	1859	"	*
1110	514	1865	"	*
1111	513	1863	"	*
1112	510	1864	"	*
1113	260	1867	"	
1114	262	1868	"	
1115	259	1866	"	
1116	261	1863	"	
1117	257	1865	"	
1118	258	1867	"	
1119	264	1859	"	
1120	263	1870	(No)	
1121	314	1867	Yes	
1122	315	1861	"	
1123	313	1864	"	
1124	317	1862	"	
1125	316	1864	"	
1126	318	1868	"	
1127	319	1861	"	
1128	320	1864	"	
1129	338	1862	"	
1130	343	1865	"	
1131	342	1868	"	
1132	339	1872	"	
1133	340	1867	"	
1134	344	1862	"	
1135	341	1880	"	
1136	337	1865	"	
1137	273	1869	"	

*Updated Units - Some parts were modified to incorporate a change in assembly procedure.

C-2 175mm, Zone 3

92° azimuth (round weight 146 lbs. average)
Cold temperature conditioned at -50°F
2 min. 8 sec. flight time, qty. 10 rounds

Round No.	Fuze No.	Velocity Ft./Sec.	Function	Remarks
249	Spotter Round			
250	386	3026	Yes	
251	385	3074	"	
252	369	3042	"	
253	370	3015	"	
254	371	3024	"	
255	372	3019	"	
256	373	3019	"	
257	374	3010	"	
258	375	3079	"	
259	376	3017	"	

C-3 175mm, Zone 3

Same as C-2 except hot temperature conditioned at 145°F, qty. 10 rounds

Round No.	Fuze No.	Velocity Ft./Sec.	Function	Remarks
260	Spotter Round		Yes	
261	454	3011	"	
262	458	Lost	"	
263	443	3009	"	
264	447	3019	"	
265	444	3016	"	
266	448	3020	"	
267	445	3017	"	
268	446	3023	"	
269	449	3024	"	
270	450	3017	"	

C-4 105mm, Zone 7

84° azimuth, 500 mils elevation, cold temperature conditioned at -50°F, qty. 15 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
1434	278	1627	No	
1435	277	1625	Yes	
1436	274	1626	"	
1437	280	1635	"	
1438	275	1629	"	Reverse function
1439	276	1633	"	
1440	326	1619	"	
1441	329	1621	"	
1442	327	1622	"	
1443	323	1622	"	
1444	328	1624	"	
1445	325	1622	"	
1446	321	1619	"	
1447	322	1621	"	
1448	324	1622	"	

C-5 105mm, Zone 7

TV conditioned, 85° azimuth, 500 mils elevation, qty. 15 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
79	211	--	Yes	
80	212	--	"	
81	213	1621	"	
82	215	1623	"	
83	216	1617	"	
84	249	1615	"	
85	250	1614	"	
86	233	1613	"	
87	234	1615	"	
88	235	1612	"	
89	236	1633	"	
90	237	1618	"	
91	238	1615	"	
92	239	1609	"	
93	240	1618	"	

C-6 155mm, Zone 2

6 inch thick plywood target at 45° angle to gun
Distance 500 ft.
Qty. 15 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
	133		Yes	Long delay
	134	698	"	
	135	723	"	
	136	742	"	
	131		"	
	130		"	
	129		"	
	81		No	Functioned on ground impact approx. 800 ft.
	82		Yes	
	83		"	
	84		"	
	85		"	
	86		"	
	87		"	
	88		"	

C-7 105mm, Zone 5

4 inch thick plywood target at 45° angle to gun
Distance - 500 ft., 7.6 mils elevation
Qty. 15 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
	190	1070	No Test	Missed target
	189	1064	Yes	
	184	1053	"	
	182	1057	"	
	181	1058	"	
	191	1056	No	Functioned on ground impact
	188	1061	Yes	
	192	1063	"	
	157	1060	"	
	93	1065	"	
	158	1070	"	
	91	1068	"	
	92	1066	"	
	96	1068	"	
	132	1067	"	

C-8 155mm, Zone 2 HQE, Ground impact, ambient, 84° azimuth, 900 mils elevation, qty. 30 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
1053	494	764	Lost	*
1054	495	758	Yes	*
1055	496	755	"	*
1056	515	743	"	*
1057	516	748	"	*
1058	175	744	"	
1059	106	747	"	
1060	108	744	"	
1061	109	752	"	
1062	105	741	"	
1063	107	747	"	
1064	110	751	"	
1065	111	749	"	
1066	112	749	"	
1067	137	752	"	
1068	138	752	"	
1069	139	756	"	
1070	140	754	"	
1071	141	753	"	
1072	142	754	"	
1073	143	751	"	
1074	144	751	"	
1075	289	758	"	
1076	290	759	"	
1077	291	761	"	
1078	292	756	"	
1079	293	758	"	
1080	294	756	"	
1081	295	753	"	
1082	296	759	"	

*Some parts were modified to incorporate a change in assembly procedure.

C-9 155mm, Zone 2, HQE

Ground impact, TV conditioned, qty. 25 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
1083	217	755	Yes	
1084	218	757	"	
1085	219	760	"	
1086	220	754	"	
1087	221	756	"	
1088	222	762	"	
1089	223	--	"	
1090	224	765	"	
1091	225	761	"	
1092	226	756	"	
1093	227	758	"	
1094	228	764	"	
1095	229	765	"	
1096	230	766	"	
1097	231	763	"	
1098	232	765	"	
1099	241	760	"	
1100	242	761	"	
1101	243	768	"	
1102	244	762	"	
1103	245	761	"	
1104	246	763	"	
1105	247	759	"	
1106	248	764	"	
1107	214	766	"	

C-10 105mm, Zone 7 LQE

Ground impact, ambient, fuzes set S.Q., 500 mils elevation, qty. 40 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
1394	492	1611	Yes	*
1395	493	1630	"	*
1396	498	1626	"	*
1397	497	1618	"	*
1398	491	1615	"	*
1399	141	1626	"	
1400	145	1614	"	

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
1401	146	1619	Yes	
1402	147	1630	"	
1403	149	1617	"	
1404	305	1617	"	
1405	307	1614	"	
1406	153	1619	"	
1407	154	1615	"	
1408	155	1614	"	
1409	156	1623	"	
1410	160	1617	"	
1411	176	1617	"	
1412	159	1619	"	
1413	308	1619	"	
1414	306	1618	"	
1415	312	1621	"	
1416	297	1619	"	
1417	300	1615	"	
1418	299	1619	"	
1419	304	1617	"	
1420	303	1619	"	
1421	302	1619	"	
1422	298	1617	"	
1423	301	1614	"	
1424	311	1617	"	
1425	309	1614	"	
1426	329	1619	"	
1427	332	1616	"	
1428	336	1620	"	
1429	335	1616	"	
1430	331	1617	"	
1431	330	1619	"	
1432	334	1622	"	
1433	333	1618	"	

C-11 105mm Zone 1

4 inch thick plywood target, distance 500 ft.
Hot temperature conditioned +145°F
16.8 mils elevation, qty. 10 rounds

Round No.	Fuze No.	Velocity Ft./Sec.	Function	Remarks
1349	467		Yes	
1350	403		"	
1351	407	780	"	
1352	405	Ft./Sec.	"	
1353	404	Average	No	Functioned on ground impact
1354	486		Yes	
1355	485		"	
1356	487		"	
1357	483		"	
1358	484		"	

C-12 105mm, Zone 1

4 inch thick plywood target, distance 500 ft.
Cold temperature conditioned -50°F
16.8 elevation, qty. 10 rounds

Round No.	Fuze No.	Velocity Ft./Sec.	Function	Remarks
1369	408		No Test	Missed target
1370	409	780	Yes	
* 1371	501	Ft./Sec.	No)	Functioned on ground impact
* 1372	500	Average	No)	
* 1373	502		Yes	
* 1374	506		No	Functioned on ground impact
* 1375	503		Yes	
* 1376	505		No	Functioned on ground impact
* 1377	499		Yes	Long delay
* 1378	504		No	Functioned on ground impact

* These fuzes were modified to incorporate a change in assembly procedure. They were mistakenly used on this test.

C-13 105mm, Zone 1

4 inch thick plywood target, distance 500 ft., TV conditioned, qty. 10 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Function	Remarks
	210	669	No Test	Missed target
	209	678	Yes	
	205	676	"	
	201	673	"	
	206	678	"	
	202	681	"	
	207	683	"	
	203	683	"	
	208	683	"	
	204	681	No	Functioned on ground impact

C-14 105mm, Zone 7

4 1/2 inch thick plywood target, distance 500 ft.
Hot temperature conditioned 145°F, qty. 10 rounds

Round No.	Fuze No.		Function	Remarks
1359	471		No Test	Missed target
1360	468		" "	" "
1361	488		No	
1362	489		Yes	
1363	490		No Test	Missed target
1364	472		" "	" "
1365	469		Yes	
1366	473		No	Function on im
1367	470	5 1/2" Plywood	No	" "
1368	474	5 1/2" Plywood	Yes	

D GRAZE FUNCTIONING TESTS

All rounds were fired ground impact at distances of 325 to 850 feet. All fuzes set delay - T2 charges used.

D-1 105mm, Zone 1, Graze

Qty. 25 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Elevation (mils)	Distance (feet)	Function	Remarks
1474	255	609	10	600	No	
1475	253	646	10	600	Yes	
1476	152	660	10	600	"	
1477	310	672	10	600	"	
1478	345	673	12	650	"	
1479	346	676	12	650	"	
1480	347	680	13	650	"	
1481	348	681	14	700	"	
1482	349	683	15	700	"	
1483	350	685	16	750	"	Approx. 1°
1484	351	682	9	550	"	
1485	352	685	9	550	"	
1486	381	683	6	500	No	
1487	382	686	6	500	Yes	
1488	383	687	6	500	"	
1489	384	683	6	500	"	
1490	380	685	10	600	"	
1491	379	688	10	600	"	
1492	378	685	15.8	750	"	
1493	377	685	15.8	750	"	
1494	511	684	15.8	750	"	*
1495	507	685	15.8	750	"	*
1496	509	681	15.8	750	"	*
1497	357	688	20	800	"	
1498	354	687	25	850	"	

*These fuzes were modified to incorporate a change in assembly procedure.

D-2 105mm, Zone 7, Graze

Qty. 25 rounds

Round No.	Fuze No.	Velocity Ft. /Sec.	Elevation (mils)	Distance (feet)	Function	Remarks
49	517	1625	3°	400	No	
50	518	1614	3°	300	No	
51	519	1613	3 1/2°	550	Yes	
52	520	1618	3 1/2°	550	"	
53	521	1615	3 1/2°	550	"	
54	281	1617	4°	500	"	
55	282	1614	4°	500	"	
56	283	1615	5°	500	"	
57	284	Lost	5°	500	"	
58	285	1616	2°	400	"	
59	286	1616	2°	400	"	
60	287	1620	2°	400	"	Long delay
61	288	1618	2°	400	"	
62	361	1616	2°	400	"	
63	362	1622	2°	400	"	
64	363	1622	1 1/2°	350	"	
65	364	1623	1 1/2°	325	"	
66	365	1621	1 1/2°	325	"	
67	366	1623	1 1/2°	325	"	
68	367	1618	7 (1°)	600	No	
69	368	1618	7 (1°)	600	No	
70	148	1618	7	600	Yes	
71	256	1622	7	600	No	
72	183	1620	5	550	Yes	
73	150	--	5	550	Yes	

E PENETRATION TESTS

These tests will be conducted at a later date.

3.8 Conclusion

Phase I included specific changes to eliminate a broaching and pre-release problem which existed on previous contracts. Results of these tests indicate that the problem has been eliminated.

As part of this phase a study was made by R. Stresau Labs to determine the reliability of the M55 Detonator's propagation through the path of the DMD unit and the results were favorable.

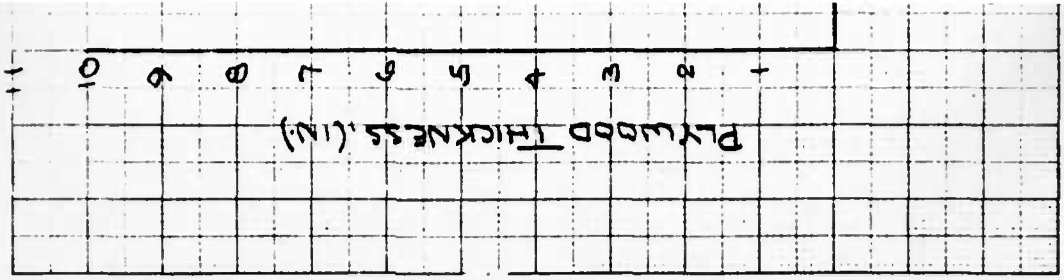
Phase II was a feasibility study conducted to test the use of zinc die casting in place of machined brass on the plunger. Tests have indicated that the properties of zinc are adequate to the performance of the device and the part cost will be lowered.

Phase III was a qualification study conducted to establish and improve the final design of all parts including changing the Firing Pin Holder from machined aluminum to die cast zinc.

Although approximately 900 units were tested for environment and ballistics with satisfactory results, a follow-on task should follow to finalize the unit's design and tooling for future production.

EN

DAT
FILM


1 2 3 4 5 6 7 8 9 10 11
PLYWOOD THICKNESS (IN.)

*Updated Units - Some parts were modified to ... assembly procedure.